AMERICAN ENGINEER

CAR BUILDER AND RAILROAD JOURNAL.

JANUARY, 1896.

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The Mexican Central is in the market for 150 box and 50 stock cars.

The Duluth, Missabe & Northern has ordered 400 new ore cars.

The Metropolitan Elevated Railroad of Chicago, has ordered 25 new passenger cars.

The Chicago & Grand Trunk is about to order four passenger cars.

The Cleveland, Cincinnati, Chicago & St. Louis will shortly order six parlor cars.

It is stated that the Pennsylvania Railroad is about to order 2,000 new box cars.

The Louisville, New Albany & Chicago Railroad has recently ordered 100 new stock cars.

The Portland & Rochester Railroad has ordered 15 new gondola coal cars of 60,000 pounds capacity.

The Toledo, St. Louis & Kansas City will shortly purchase 500 gondola cars.

The Peru (Ind.) shops of the Erie Railway, have just completed 50 refrigerator cars for a brewing company in Cincinnati.

The New York, New Haven & Hartford has increased the wages of freight brakemen west of New London from $1.90 to $2 a day and firemen from $2 to $2.10.

The Southern Pacific discharged several hundred men employed in its shops at Sacramento, on Dec. 7. The force was reduced about one-fourth.

The Denver & Rio Grande is having 550 new freight cars built for early delivery. They are to be of 60,000 pounds capacity.

The four boys who wrecked the fast mail train on the New York Central in November are being held for trial on the charge of murder in the first degree.

The Midland Terminal Railway completed its road to Cripple Creek Dec. 19, and the first train from Denver ran direct into the town on that day.

An express car in transit on the Pennsylvania road caught fire and was consumed Dec. 18, all its contents being destroyed except the safe.

The boiler of a Pennsylvania Railroad locomotive exploded at Princeton Junction on the night of December 23, instantly killing the engineer and wrecking several cars.

It is stated that a large concern for the manufacture of street cars will be built near Steubenville, O., by capitalists from Chicago, Pittsburgh and Wheeling.

The Midland Terminal Railroad, of Colorado, is in the market for five locomotives, and will also soon purchase 10 passenger cars and 100 freight cars.

The Boston & Albany is about to order several locomotives similar to the Schenectady locomotives built last year for handling the limited trains between Springfield and Albany.

What is said to be the largest pane of plate glass in the country is in a window in Hartford, Conn. It was made in Belgium, and is 12½ feet high, 15½ feet wide, half an inch thick, and weighs 1,800 pounds.

The Illinois Central will soon order an additional 200 cars. The specifications include the American steel freight car truck manufactured by the American Steel Foundry Company of St. Louis.

It is now reported that Mr. Webb will remain in the London & North Western Railway as its mechanical engineer, the rumors of his retirement being apparently groundless.

The Northern Pacific earned nearly $400,000 more in November last than in November, 1894. The statement just issued is as follows: Net earnings, November, 1894, $783,019; November, 1895, $1,178,592; increase, $395,573.

The approximated gross earnings of all lines of the Achison, Topeka & Santa Fe Railway for December were $813,608; for the same period of 1894, $759,772; increase, $53,836.

The dedication ceremonies of the new engineering laboratory of Purdue University, Lafayette, Ind., were held Wednesday, Dec. 4. This building replaces the old laboratory which was destroyed by fire on the night of Jan. 28, 1894.

It is stated that the new Board of Directors of the Atchison road has abrogated the old agreement with the Pullman Company, and that it will probably follow the example of the St. Paul road in running its own sleeping cars.

The United States Car Company has secured an order from the Chattanooga Southern Railroad Company for 100 cars, which will be built at the Anniston shops. This plant has just been made ready for operation, after being closed about two years.

Late in December a report was current in Baltimore to the effect that a consolidation of the Baltimore & Ohio Railroad and the Southern Railway is among the possibilities of the near future. This would be a transaction of the greatest magnitude and would combine in one vast system nearly 7,500 miles of road.

The fiat has gone forth that in future all carriages run upon the West Coast Scotch expresses shall be bogie vehicles; all the six-wheeled and radial axle box stock is to be withdrawn, and all the eight-wheeled carriages with radial axle boxes are to be sent to Wolverhampton and put on bogies.

A meeting of the stockholders of the New York and Long Island Railroad was held on Dec. 15 in New York. It was voted to increase the capital stock of the company from $100,000 to $20,000,000. The plan is to construct a railroad tunnel from Long Island City under New York to Jersey City.

Tramps have been making sleeping quarters of the depots along the Philadelphia & Reading Railroad. Several small stations have been burned. The officials of the road had a raid made on the tramps recently, capturing 31. They were taken to Norristown and placed in the workhouse.

The Baldwin Locomotive Works are building an eight-wheel locomotive for the Jacksonville, Louisville & St. Louis Railroad. The engine will have 17 inch by 24 inch cylinders, and will weigh about 96,000 pounds, 60,000 pounds of which will be carried on the drivers, which are 63 inch diameter and have Baldwin wrought iron centers.

The Delaware, Lackawanna & Western is becoming famous for its frequent and disastrous train wrecks. On Dec. 15 it experienced a rear end collision of freight trains near Dover, N. J., that instantly killed a stockman and a large number of live stock. A locomotive and several freight cars were wrecked.

Is there to be no limit to the development of the trolley car? There are trolley postal cars, trolley party cars, and trolley theater cars are promised. And now comes forward a genius who seriously proposes to run trolley lunch or dining cars, enabling busy men to take their meals while on their way to or from business.—*New York Tribune.*

The Westinghouse Air-Brake Company on Dec. 9 filed in the United States Circuit Court for the District of Maryland a complaint in a new action against the Boyden Brake Company for infringement of patent No. 360,070. This suit is understood to be directed against the new triple valve which the Boyden Company is now manufacturing.

A bill has been introduced in the United States Senate by Senator Quay, asking for an appropriation of $25,000 for the Franklin Institute and Purdue University, for the purpose of determining the quantity and effect of hammer blow, "centrifugal lift and tangental throw" of locomotive wheels in use on American railroads; also the effects produced thereby.

While a passenger train on the Siberian Railway was running at a high rate of speed, Dec. 19, the carriage in which Count Golovine was traveling with his wife and two children caught fire. The flames spread so rapidly that the Countess and her two children were unable to escape, and were burned to death. The Count saved his life by leaping from the train.

The American-China Development Company filed articles of incorporation at Trenton, N. J., Dec. 20. The avowed purpose of the corporation is to operate railways, steamship, telegraph and telephone lines in China. The capital stock of the company is $1,000,000. Among the corporators are Frank Trenholm, of New York; D. H. Lyon, of Greenwich, Conn., and S. S. Walters, of Jersey City.

The Pennsylvania Railroad is building from a point on the New York division near North Penn. Junction to Bustleton, from which an extension will be made about 16 miles to the vicinity of Trenton. The completion of this branch will give it almost an air line between Trenton and Philadelphia. It will be used specially for fast trains. Surveys are being made with a view to cutting off about a mile between Harrisburg and Altoona.

The proverbial three wrecks occurred on the Norfolk & Western Railroad, in Virginia, between midnight and morning, Dec. 11. The first occurred at the Norfolk & Southern Junction, a few miles west of Norfolk; the second near Windsor, and the third about three miles from Ford's Station. The trains were freights, and almost 20 cars were wrecked. The tracks were badly blocked, and all trains were delayed from two to three hours. No one was injured.

A French journal describes a new and promising substitute for gold. It is produced by alloying ninety-four parts of copper with six of antimony, the copper being first melted and the antimony afterward added; to this a quantity of magnesium carbonate is added to increase its specific gravity. The alloy is capable of being drawn out, wrought and soldered just as gold is, and is said to take and retain as fine a polish as gold. Its cost is a shilling a pound.

The New York State canals were officially closed on Dec. 5. In spite of low railroad rates, the past season has been a fairly good one for the boatmen. The total falling off in tons carried on all the canals during the season of 1895 was only about 10 per cent. In 1894 the number of tons carried was 3,882,560. This year, up to Dec. 1, the number of tons carried was 3,467,848, a loss in tons of 414, 712. The clearance since December will reduce the difference somewhat.

The *Railway Herald* says: The West Coast Joint Stock is to be increased by 100 new bogie carriages, which are to be built at the London & North Western Railway works, at Wolverton. We trust that they will be fitted with that system of spiral suspension bolster springs already adopted by the London & North Western Railway, which gives much better results with regard to steady and smooth running than the ordinary elliptical laminated springs formerly in use.

The production of pig iron in 1895 has verified the predictions made early in the year that if the rate of output at the time was maintained for the year the record of tonnage would be exceeded. The total output according to official figures compiled by the *American Manufacturer*, shows a production of 9,387,689 tons, exceeding 1890, the largest previous year, which had a tonnage of 9,202,703 tons. In 1893 the output was 9,157,000 tons. The tonnage of 1894 is exceeded by 730,251 tons.

All efforts to straighten out the Northern Pacific receivership tangle have proved unavailing. Repeated conferences have been held, but each succeeding discussion has widened the gulf between the Eastern and Western interests. Authentic information states that the Eastern interests which seem to be opposed to Judge Hanford have determined if possible to secure the passage of a law by Congress this winter, the effect of which will be to deprive Judge Hanford of jurisdiction. This, it is said, explains the long delay in approaching the adjustment of the united receivership of the road.

A happy instance of possible justice being tempered by sure mercy was the Thanksgiving proclamation of Superintendent Charles A. Beach, of the Buffalo division of the Lehigh Valley Railroad, stating that: "The Thanksgiving of such employees as have, unfortunately, been suspended for infractions of discipline, may not be a disappointing one, all such are hereby notified that the balance of their term of suspension need not be served; they may resume work at once." We are sure that the interests of the company were advanced by this act quite as much (and in dollars and cents much more) as were those of the employees concerned.

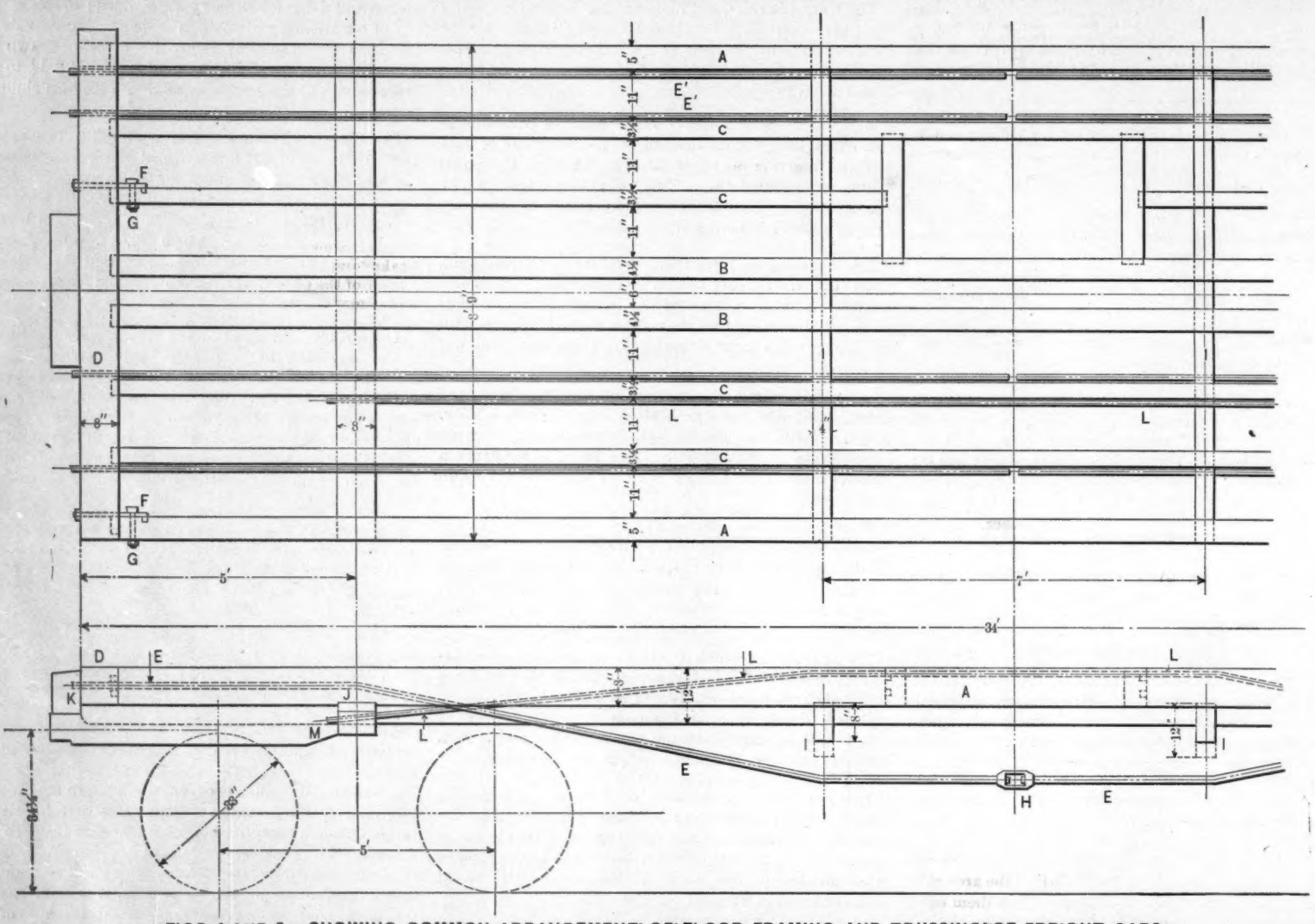
Truckee, a little town on the Central Pacific, which is very near the Nevada line and also very close to the summit of the Sierra Navada range, proposes to open on Jan. 1 an ice palace which will have some novel features. There will be toboggan slides and skating ponds, but what makes it unique is that only 80 miles away, at Newcastle, orange groves will soon be in bloom and the trees now hang heavy with the golden fruit. The difference between the two places is solely the difference of altitude, but it is doubtful if any part of the world, except Hawaii, can afford such remarkable contrasts of climate within the same distance. Truckee also promises sleigh rides to Lake Tahoe, one of the most beautiful sheets of water in this country.

Construction and Maintenance of Railway Car Equipment. I.

BY OSCAR ANTZ.

About seven years ago a series of articles was published in these columns, and afterward in book form, by Mr. Wm. Voss, on the construction of railway cars. These articles covered the subject pretty thoroughly as far as the cars then in use were concerned, but since then the demand for cars of larger carrying capacity and greater strength, and of others adapted to different purposes, has brought about changes in the dimensions and design, and in some cases has led to new types of cars differing from those then in existence.

The natural tendency to progress and improvement has brought into use a large number of appliances of more or less meritorious design, and the necessity of equipping freight cars with power brakes and automatic couplers to comply with national legislation has filled the market with the results of the ingenuity of inventors; and it will be the purpose of this and some subsequent articles to describe the improvements made in railway car equipment in the last few years, and to outline the possible changes which may take place in the near future. It is not intended that these articles should be an elaborate description of every kind of car in use, but merely to give a general idea of the best practice as it exists today in this country in the construction of railway cars.



FIGS. 1 AND 2. SHOWING COMMON ARRANGEMENT OF FLOOR FRAMING AND TRUSSING OF FREIGHT CARS.

It is, furthermore, not pretended that very much, if any, new matter will be presented, as nearly every new car which has been put into use in the last few years has been more or less described and illustrated in the railroad and engineering journals, and a series of articles like these can only give in a general way the improvements made over the old practice, and the latter must be referred to at times to illustrate the new methods.

UNIFORMITY IN CAR CONSTRUCTION.

With the developments of modern railroading and the large amount of interchanging of cars among the different roads the necessity for uniformity in their different parts and especially of those used in freight service, not only of one road but of all railroads of the country is made more and more apparent, and the standardizing of such parts of passenger and freight cars as are most liable to damage and thus needing replacement, has been a most important part of the work of the Master Car Builders' Association.

In the earlier days of railroading cars were built according to the ideas and prejudices, often, of the person in charge of the car department of the road for which they were intended, without much regard to others on the same or other lines, and without making much provision with reference to repairing them. The length of the cars was often determined by the length of the timber which happened to be on hand for sills, and the size of many other parts was also dependent on the material on hand. In later years, when many cars were built by car manufacturers and not by the railroad companies each one of these manufacturers had his own ideas and as they were usually not restricted to any details further than perhaps the kind, size and cost of the cars, the result was that if they patronized different manufacturers, railroad companies often had a great variety of such equipment.

Therefore, we find among the older cars almost as many different kinds as there are numbers, and when it is necessary to renew any part the old piece must often be obtained to make the new one from it. Very few drawings were made in those days, and each part had to be put in place before the next one was started. Castings and forgings were made to fit as occasion would require, and, especially where a foundry was conveniently near, each car often had some casting peculiar to itself.

At the present time, with the enormously increased number of cars and the large amount of interchanging of traffic between different roads, the question of repairs has become quite a serious one, and cars are now built so as to facilitate as much as possible the repairs of such parts as most frequently fail in service. Furthermore, the same parts in different kinds of cars are made alike whenever possible. Castings especially are reduced in variety, and even in the early days of the Master Car Builders' Association standards were established for a number of castings which were adopted by many roads.

Some of the standards for certain parts were, however, not established by the Master Car Builders' Association until some roads had adopted different standards of their own, and had built cars according to them. These roads were naturally not very desirous of changing to some other plan perhaps not better than their own, and we therefore find even in modern cars many variations from the M. C. B. standards, which make more or less trouble on roads which adhere strictly to these standards.

In order to avoid, if possible, this state of affairs in future, standards should be established in advance for cars differing in capacity from those now in existence, and which the requirements will from time to time demand, and the Master Car Builders' Association has already taken up the subject of standard parts for freight cars of 80,000 pounds capacity, which it seems from present indications will be one of, if not *the*, freight car of the near future.

It should be the endeavor of all car builders to follow these standards, when adopted, indiscriminately, even if necessary to discard a pet idea or former practice.

FREIGHT CAR CONSTRUCTION.

A description of those freight cars for the railroads of this country which have been built in recent years can be based on the supposition that the necessity for standardizing this equipment has been recognized by railroad managers and that the cars have been built in pursuance of this policy, the subject can then be treated first in general way, describing such parts as are usually alike in all classes of cars, and then taking up each class individually.

There is still a wide discrepancy in the size and shape of similar parts of cars on different roads, and in the limited description which can at best be given in these articles, only such as seems to be the average good practice will be touched upon.

CAPACITY.

Nearly all freight cars that have been built in later years have a capacity of 60,000 pounds or more, and probably it will be but a short time before most cars of smaller size will be taken out of service or be assigned to remote divisions where the traffic is light, or to some special service in which they will not be put into the same trains with heavier cars. Some cars of over 60,000 pounds capacity are at present in use; ore cars of 80,000 pounds capacity have been in use for several years on a number of roads; coal cars of a capacity of 70,000 pounds have recently been built in considerable numbers by another road, and the building of cars of 80,000 pounds capacity for regular service is receiving serious consideration throughout the country.

These large cars may, however, be considered as yet in the experimental stage, and they will be treated by themselves later on; in the description immediately following only cars of 60,000 pounds capacity will be considered.

DIMENSIONS.

The length of a 60,000-pound freight car is generally from about 34 to 36 feet long over its end sills; the former length is largely adopted by roads which do not use an end platform; the latter length is necessary with end platforms to get an effective inside length of about 34 feet.

The width of these cars varies from 8 feet 6 inches to 9 feet over the side sills, depending somewhat on the attachments on these sills, as the width over all must be kept within certain limits.

In these dimensions there has been practically no change from lighter cars, those of 40,000 to 50,000 pounds capacity having been built of about the same size; the height, however, on cars with a superstructure has been generally increased.

The height is determined by the class of the cars and the service in which they are employed. Closed cars, having a roof and side doors can be built as high as obstructions on the road will allow, while open or gondola cars which must be loaded over the sides be low enough to be loaded with economy. These dimensions will be given under their proper heads.

There is a demand at present for box cars of a larger internal cubical space than that which the ordinary box cars have, and of the same weight carrying capacity. This demand is the result of an arrangement of freight rates by which certain minimum weights are charged for, on light and bulky material in car load lots, even when the load does not weigh the prescribed amount. Naturally the shippers of this kind of freight demand large cars and the "Large Car Question" is now receiving a good deal of attention from railroad men.

Furniture cars have been built by some roads to meet this demand and these will be described later. Their usua

dimensions, which are given here for comparison, are: length, 40 feet over end sills; width, slightly less than 10 feet over all, and extreme height about 13 feet.

FLOOR FRAME.

The increased capacity of freight cars necessitated a general strengthening of parts, and we meet this first in the floor frame.

In Figs. 1 and 2 is shown a floor frame which can be taken as an average of ordinary cars, the length shown being 34 feet over end sills; the upper half of the plan view represents the frame of a car having a central opening for drop doors, the lower part showing one for a solid floor.

LONGITUDINAL SILLS.

The longitudinal sills are eight in number and are usually of yellow or Norway pine; they are almost universally 8 inches in depth, excepting on cars without any framed superstructure, on which the side sills, *AA*, are made stronger, generally 12 inches deep.

The width of these sills varies more or less with different builders, but is usually 4½ or 5 inches for center, *BB*, and side sills, *CC*, and 3½ or 4 inches for intermediates.

The spacing of the sills is determined somewhat by other details of the car, thus the center sills are spaced to suit the draft rigging, and the intermediates depend somewhat on details of body bolster and on truss rods for their location, but it is usually endeavored to get as nearly an even spacing as is possible, with the center sills in the line of greatest stress.

On cars having a low frame, such as furniture cars, it is furthermore necessary to space the sills so as to allow the car to move over sharp curves without having the wheels strike the sills. When a certain spacing has been decided on as a standard, it should be adhered to as far as possible even on cars of different width, the difference being allowed between the outside intermediate and the side sill; this will bring all parts of the body bolsters alike, excepting the ends. The longitudinal sills are framed to the end sills, *D*, usually by double tenons, and are held to them by the body truss rods, *E E;* additional strength is given by bolts, *F F*, passing through the end sills and ending in a plate and lug; the lug is let into the longitudinal sill and a bolt, *G G*, passing through the sill and plate, holds them securely. These lug bolts should always be provided where the end sill is unsupported for any unusual distance by truss rods, or when a truss rod does not come close to the side sill. In the latter case these bolts can be utilized to hold the corner plates, if these are used.

The floor frame of freight cars is subjected more or less to influences which cause it to rot, and this is especially the case where two pieces of timber are close together allowing water which gets in to remain there, as it does between the tops of sills and the bottom of the floor, and in the joints between the sills. To prevent this tendency to rot a liberal coat of "Fernoline" oil should be applied to these places before the timbers are put together.

END SILLS.

The end sills, *D*, of freight cars are subjected to severe blows and must be made very strong. They are usually made of oak, although in the South yellow pine is sometimes used.

End sills are not less than 8 by 8 inches in section and are often made larger than this. They are almost universally now framed to the ends of all of the longitudinal sills, thus extending to the extreme width of the car. Where they are not enclosed by sheathing, or where corner bands are not used, they should extend a few inches beyond the side sills.

TRUSS RODS.

With the general strengthening of the cars, the trussing of the frame has also undergone some changes and there are now at least four truss rods, which are 1¼ inches or more in diameter, with the ends enlarged so that the area at the bottom of the screw threads which are cut on them equals or slightly exceeds that of the body of the rod.

The rods are made in two parts, joined at the center of the car by turn buckles, *H*, with right and left hand screws; these turn buckles are prevented from turning, when screwed up, by pieces of wood passed through two or more of them, and held place by bolts or lag screws through the wood on the sides of the turn buckles.

The truss rods pass under bearings or "queen-posts" on the cross-tie timbers, *II*, which are generally about 8 inches deep, then over saddles on the body bolster at *J*, and then through the end sills, *D* at *K*, where large washers are placed under the nuts on the rods. Some builders put cast-iron sockets in the end sills for the truss rod nuts to rest in, so as to have no projections over the face of the sill.

The bends in the rods should not come quite close to the saddles and bearings, as there is a liability of tilting these when the rods are being screwed up, if the bends come hard against the casting.

The location of the truss rods with respect to the longitudinal sills is determined somewhat by the attachments on the end sills, and furthermore they must be so placed that they will not come in contact with the wheels or other parts of the trucks. Other details which determine the location are doors in the floor and the air-brake apparatus. In the upper part of Fig. 2, the two truss-rods *E' E'* are shown between the side sill and outside intermediate, as hey would come in the way of the doors if located nearer the center of the car.

It is usual to place the rods close to some of the longitudinal sills, so as to tie these well to the end sills and to get a good fastening for the truss-rod saddle.

Flat or platform cars, having no superstructure at all, are liable to be bowed up at the center when empty and placed between heavy cars when the train is suddenly stopped. To resist this tendency, inverted truss rods, *L L*, of ¾ or 1-in. round iron are therefore used, which rest in saddles on the cross-tie timbers. These rods are located as high as they can be between the timbers and the floor, and their ends pass through the body-bolsters at *M* with large washers and nuts bearing on these, the ends of the rods being enlarged for the threads.

CAMBER.

If the top of a car were made perfectly straight it would sag down at the center when loaded. The truss-rods resist this tendency to some extent, and to further stiffen the car it is given camber; that is, it is curved upward at the center to 1¼ to 1½ inches from a straight line. This camber is obtained usually by drawing the frame down at the ends by means of turn-buckles made fast to the floor of the shop and raising up at the center by jacks. On cars with a framed superstructure this camber is preserved by making the braces and posts of the proper length and by the introduction of tie and brace-rods, and the truss-rods are used as an additional means of holding the car up under load. On cars without any framed body the camber is preserved entirely by the body truss-rods.

When in service, body truss-rods should be tightened up frequently to preserve the camber and to prevent the wearing of the joints between the sills and the consequent racking of the car.

CROSS-TIE TIMBERS.

Cross-tie timbers do not add much to the strength of a car, being used principally to hold the longitudinal timbers in place laterally at the center of the car and keep them from spreading, and also to provide a support for the truss-rod bearings. They are usually made of the same material as the end sills, and are about 4 by 8 inches in section, and extend to the outside of the side sills; they are gained or notched out a half inch for each longitudinal sill. There are generally two cross-tie timbers to a car, spaced from 6 to 8 feet apart. Some cars are occasionally found with only one of these timbers at the center of the car.

When the side sills are deeper than the other sills of a car, the cross-tie timbers are also made correspondingly deeper, and are cut out the same amount under the side sills. The cross-tie timbers are fastened to the longitudinal timbers by ¾-inch bolts, one at each timber, and some of these bolts usually hold the body truss rod bearings also. Some builders place the cross-tie timbers slightly out of plumb to better resist the pressure from the truss rods.

(To be Continued.)

Reading Reorganization Plan.

The plan for the reorganization of the Philadelphia & Reading Railroad Company and its subsidiary companies was made public Dec. 15. Under the plan the following securities will be created: General mortgage 100-year 4 per cent. bonds, $114,000,000; non-cumulative 4 per cent. first preferred stock, $28,000,000; non-cumulative 4 per cent. second preferred stock, $42,000,000; common stock, $70,000,000.

The general mortgage will provide for the issue, if found desirable, of additional bonds to meet the outstanding Philadelphia & Reading terminal bonds and Philadelphia & Reading Coal and Iron bonds. The mortgage will be based upon properties or securities of all the lines of railroad owned by the company, 327 miles; various leasehold lines, 532 miles, and all property of the Coal and Iron Company representing nearly 200,000 acres of coal and timber land. It will also have the benefit of equipment, valued at about $10,000,000, but now subject to about $7,300,000 of car-trust obligations, which are to be acquired under the plan, and also the marine equipment of the company.

Of the bonds $20,000,000 will be used for new construction, additional equipment, etc., under carefully-guarded restrictions not over $1,500,000 to be used in any one year. Provision is made that, at any time after dividends at the rate of 4 per cent. a year shall have been paid for two successive years on the first preferred stock, the company may convert the second preferred stock at par, one-half into first preferred stock and one-half into common stock, and the amounts of these latter may be increased in conformity. The assessments are 20 per cent. on the first, second and third preference income bonds; 20 per cent. ($10 per share) on the stock, and 4 per cent. on the deferred income bonds.

As set forth in the plan, the annual fixed charges of the reorganized system will be about $9,300,000. An almost immediate reduction of nearly $500,000 per annum in these fixed charges will, however be effected through the refunding or extension of the various bonds shortly to mature.

The net earnings of the system for the last four years, terminating Nov. 30, have been: 1892, $12,472,190.60; 1893, $11,172,690.56; 1894, $9,839,971 32; 1895 (estimated), $9,624,123. With a syndicate of $48,000,000 behind the undertaking there can be no doubt of the ability to meet all financial requirements that may arise.

Master Mechanics' Association Circulars.

Locomotive Steps and Handholds.

The committee of the Master Mechanics' Association appointed to report upon the subject of steps and handholds on locomotives and tenders has issued a circular of inquiry in which the following questions are asked:

What form of steps and handholds do you prefer leading to gangway of cab?

Do you consider the common arrangement of a step, each, on back of engine and front of tender sometimes confusing and dangerous?

Do you favor the arrangement of wide steps depending from the front of tender frame, dispensing with the engine step?

What arrangement of steps and holds do you prefer leading (1) to the headlight, (2) to sandbox?

What form, if any, of steps and handholds do you use or recommend at back end of tender?

Please forward your replies, with such drawings or prints as may be convenient, to John Medway, Superintendent of Motive Power, Fitchburgh Railroad, Boston, Mass.

John Medway, H. Bartlett, J. T. Gordon, F. M. Twombly, G. H. Baker, Committee.

The following circular has been issued by the committee on

Driving-Box Wedges:

Have you ever had any experience with locomotives whose driving-boxes were not put up with adjustable wedges? If so, please give us the results of your observations.

Do you think that a close-fitting box put up between a shoe and a fixed wedge (that could be lined only by a machinist when occasion required), would be a better method of construction than the present one of a movable wedge?

If in favor of the stationary wedge, please say how ought the box to be fitted in order to give the longest mileage without risk of the box sticking when the engine is first turned out?

Will you, for experimental purposes, equip an engine with stationary wedge, and run it some four or five months, and report results to us?

Are not the majority of hot boxes (not hot journals) caused by enginemen setting up movable wedges too tight?

Now that so many side rods have bushed ends, and are therefore not adjustable as to length, is it not advisable to take from enginemen the power of varying the distances apart of the axle centers, as can now be done on an engine with movable wedges?

Do not stationary wedges break off fewer axle box flanges than movable wedges

If stationary w s were not used, or in other words, if new engines had the frame pedestals forged with parallel faces and then fitted with pedestal blocks paralleled in every way, so that the new pedestal blocks as they came from the milling machine could be used interchangeably, either front or back, up or down, would it probably increase the risk of failure on the road by fractures of the frames?

Under the above conditions, would the engine tend to come back to shop for repairs, having made less mileage than if equipped with wedges?

Also, under the above conditions, would engine be appreciably less economical in the use of steam, during, say the last half of her mileage?

Will our members oblige the Association, and this Committee, by early replies to the foregoing questions, addressing J. Davis Barnett, Stratford, Ontario, Can.?

J. Davis Barnett, H. A. Childs, T. J. Hatswell, R. Atkinson, R. E. Redding, Committee.

Location of Atchison's Officers.

The headquarters of the executive officers of the reorganized Atchison, Topeka and Santa Fe Railway Company will be located as follows:

In New York—Chairman of the Board, Aldace F. Walker; Comptroller, John P. Whitehead: Assistant Secretary, L. C. Deming, and Assistant Treasurer, George C. Goodwin.

In Chicago—President, E. P. Ripley; First Vice-President, D. B. Robinson; Third Vice-President, Paul Morton; Freight Traffic Manager, W. B. Biddle; Passenger Traffic Manager, W. F. White; General Freight Agent, W. A. Bissell; General Passenger Agent, George F. Nicholson; General Solicitor, E. D. Kenna, and General Auditor, W. K. Gillette.

In Topeka—General Manager, J. J. Frey; Secretary and Treasurer, Edward Wilder; General Superintendent, H. U. Mudge, and Superintendent of Machinery, John Player. In addition these officers will have their headquarters in Topeka. Chief Engineer, General Claim Agent, Assistant General Freight Agent, Assistant General Passenger Agent, Superintendent of Telegraph, and Tax Commissioner, Master Car Builder and Superintendent of Car Service.

Among the deep coal mines in Europe is one at Lambert, Belgium. Depth, 3,490 feet.

The Terre Haute Car and Manufacturing Company has passed out of the hands of an assignee and the plant will be put in readiness to begin work in January.

A despatch from Peking states that an imperial edict has been issued ordering the construction of a double-track railway between Peking and Tien-Tsin, a distance of 72 miles. The rails used will weigh 85 pounds to the yard and the cost of construction will be about $3,000,000.

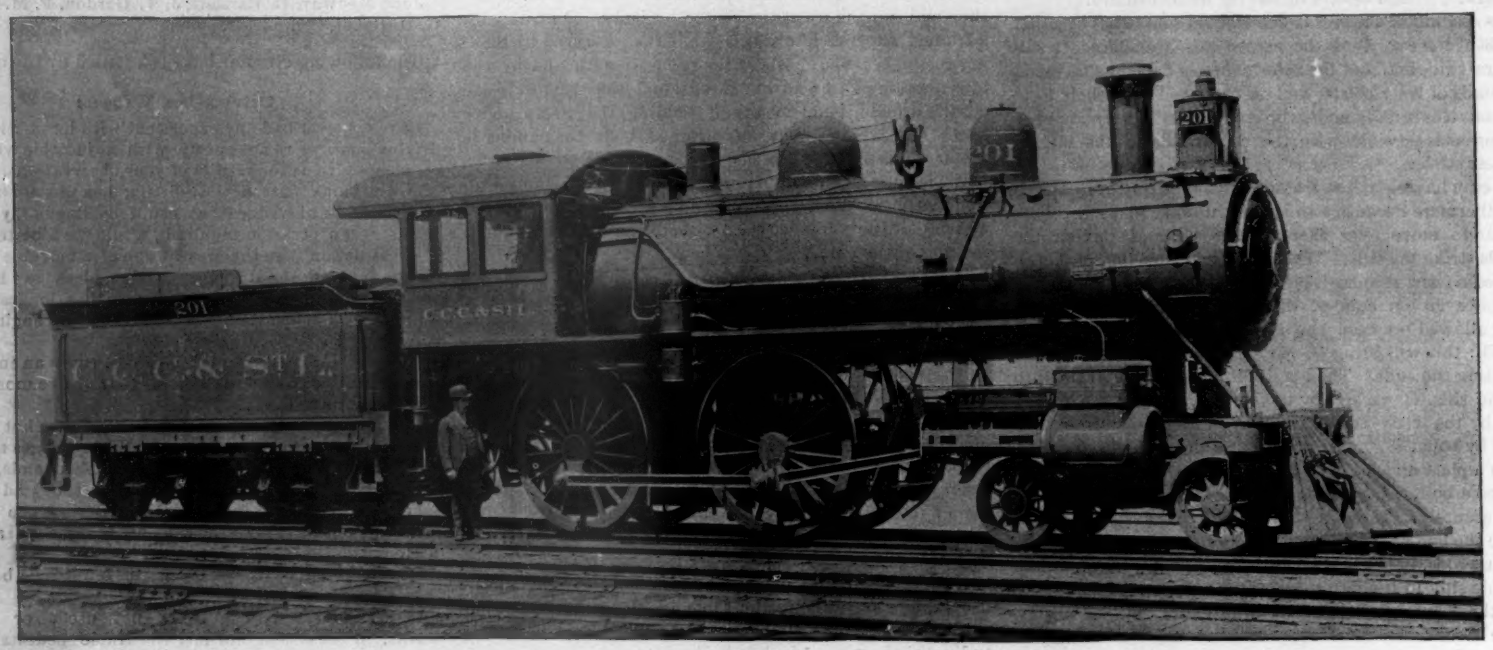
Two Notable Locomotives.

We herewith present photo-engravings of two powerful simple locomotives built for special heavy fast passenger service on Western roads. Both engines were built by the Schenectady Locomotive Works. Our first engraving shows one of two similar engines built for the Cleveland, Cincinnati, Chicago & St. Louis Railway. According to the designs of Mr. William Garstang, Superintendent of Motive Power of the road. These engines were procured to handle the heavy passenger trains on the grades of the Cleveland & Cincinnati Division from Cleveland to Galion. The train which they are designed to haul is No. 11, leaving Cleveland at 3:30 p. m. and arriving at Galion at 5:40 p. m. The distance covered in these two hours and ten minutes is 79.8 miles and there is a total ascent of 595 feet.

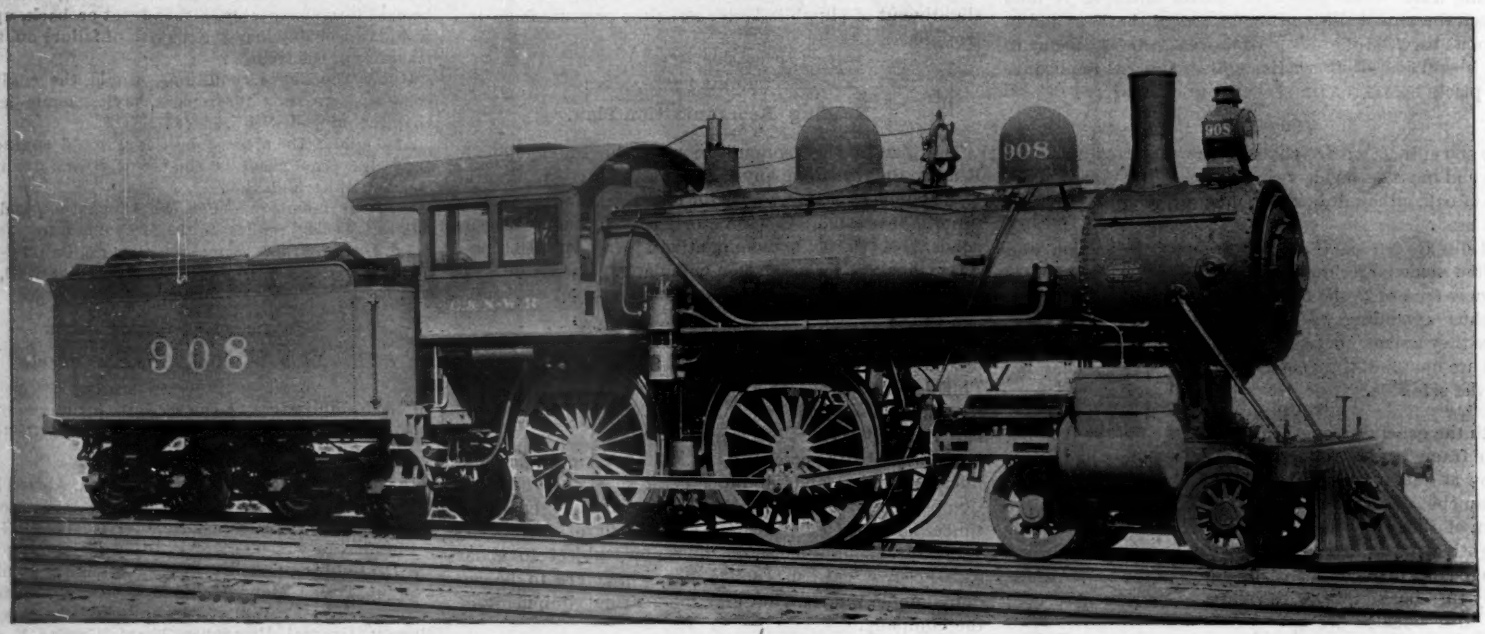
The great height of the engine above the rails prevented the placing of the safety valves on the dome and they were put back of it, as shown in the engraving.

Heating surface, firebox	179 sq. ft.
" " tubes	1,996 sq. ft.
" " total	2,175 sq. ft.
Grate area	30.75 sq. ft.
Drivers, diameter	72 in.
" material of centers	cast steel
Truck wheels, diameter	Steel tires, 33 in.
Journals, driving axle, size	8¾ × 11½ in.
Main crank pin, size	5½ × 6½ in.
Cylinders, diameter	20 in.
Piston, stroke	24 in.
" rod, diameter	3½ in.
Kind of piston rod packing	Jerome metallic
Steam ports, length	20 in.
" width	1⅝ in.
Exhaust ports, length	20 in.
" width	3 in.
Valves, kind of	Allen Richardson
" greatest travel	6 in.
" outside lap	1⅛ in.
" inside lap or clearance	Line and line
" lead in full gear	⅛ in.
Boiler, type of	Radial stayed wagon-top
" working steam pressure	200 lbs.
" material in barrel	Carbon steel
" thickness of material in barrel	⅝ in.
" diameter of barrel inside	61 in.
Seams, kind of horizontal	Double riveted butt
" " circumferential	" " lap
Thickness of tube sheets	½ in.
" crown sheet	⅜ in.

diameter of the boiler at the first ring is 62 inches and the height of center of boiler above rails is 8 feet 8 inches. The diameter of the piston is 3½ inches, except where it enters the crosshead, and there the diameter is increased to 3¾ inches. This was done to strengthen it at the point where the most frequent breakages have occurred. Cast iron gibs are used on the crosshead instead of brass ones. Cast steel is used in a great many places in order to get the necessary strength combined with lightness. The piston, crosshead, wheel centers, dome ring and deck plate are made of this material. The whistle is not put on the left hand side of the dome, as is frequently done, but is located at the same place as the safety valve. By this arrangement not only is the dome given a more symmetrical appearance, but should it be necessary to remove the covering, the boiler need not be blown off and the whistle removed. The interior arrangement of the cab is neat, half of the back head of the boiler being lagged and covered with planished iron. Platinum leaf is used for



Heavy Fast Express Locomotive; Cleveland, Cincinnati, Chicago & St. Louis Ry.



Heavy Fast Express Locomotive; Chicago & Northwestern Ry.

One of the most striking features of its construction is the large boiler and firebox. The boiler is 72 inches in diameter, and the firebox is 9 feet long. The crown sheet is stayed with radial stays, the first two rows being sling stays. The dome is attached to the boiler by a flanged ring. The total heating surface is 2,175 square feet, about 245 square feet more than the 999 of the New York Central possesses.

The pistons and rods and driving-wheel centers are made of cast steel for lightness. The driver has a cast-iron ring, ½ inch thick, shrunk on the inside of the hub. The design of the crosshead is for the standard four-bar guides used on this road. The pistons are hollow, and have a plate of boiler steel ⅛ inch thick as a cover on the head end. Dunbar packing is used. The engine truck is of the rigid-center type, with a wheel base of 79 inches. The center plate is of cast iron. The following table gives the general dimensions:

Kind of fuel to be used	Bituminous coal
Weight on drivers	83,000 lbs.
" " truck wheels	43,000 lbs.
" total	126,000 lbs.
Wheel base, total, of engine	23 ft. 10½ in.
" " driving	8 ft. 6 in.
Height, center of boiler above rails	8 ft. 6½ in.
Tubes, number	320
" material	Knobbled charcoal iron
" outside diameter	2 in.
" length over sheets	12 ft.
Firebox, length	9 ft.
" width	3 ft. 5 in.
" depth front	76 in.
" " back	64 in.
" material	Carbon steel
" thickness of sheets	⅝ in.
" brick arch	Yes
" water space, width	Front 4 in.; sides 3½ in.; back 4 in.
Grate, kind of	Rocking finger, with drop plate
Smokebox, diameter outside	65 in.
" length	68½ in.
Netting, wire or plate	Wire netting
" size of mesh or perforation	Three meshes per inch
Stack, straight or taper	Straight

Our second engraving shows one of 12 eight-wheel passenger engines recently built for the Chicago & Northwestern Railway for heavy fast service between Chicago and Council Bluffs. The trains hauled sometime consist of 11 cars, six of which are sleepers. While the average speed between terminals is not very fast, yet there are numerous stops, causing fast running between, making it an exceedingly hard service.

The driving wheels are 75 inches in diameter, and the truck wheels are 36 inches. The cylinders are 19 inches by 24 inches, and the firebox is 8 feet and $\frac{5}{16}$ inch long. The

the numbers and lettering, and presents a handsome appearance.

The following gives the principal dimensions and points of interest:

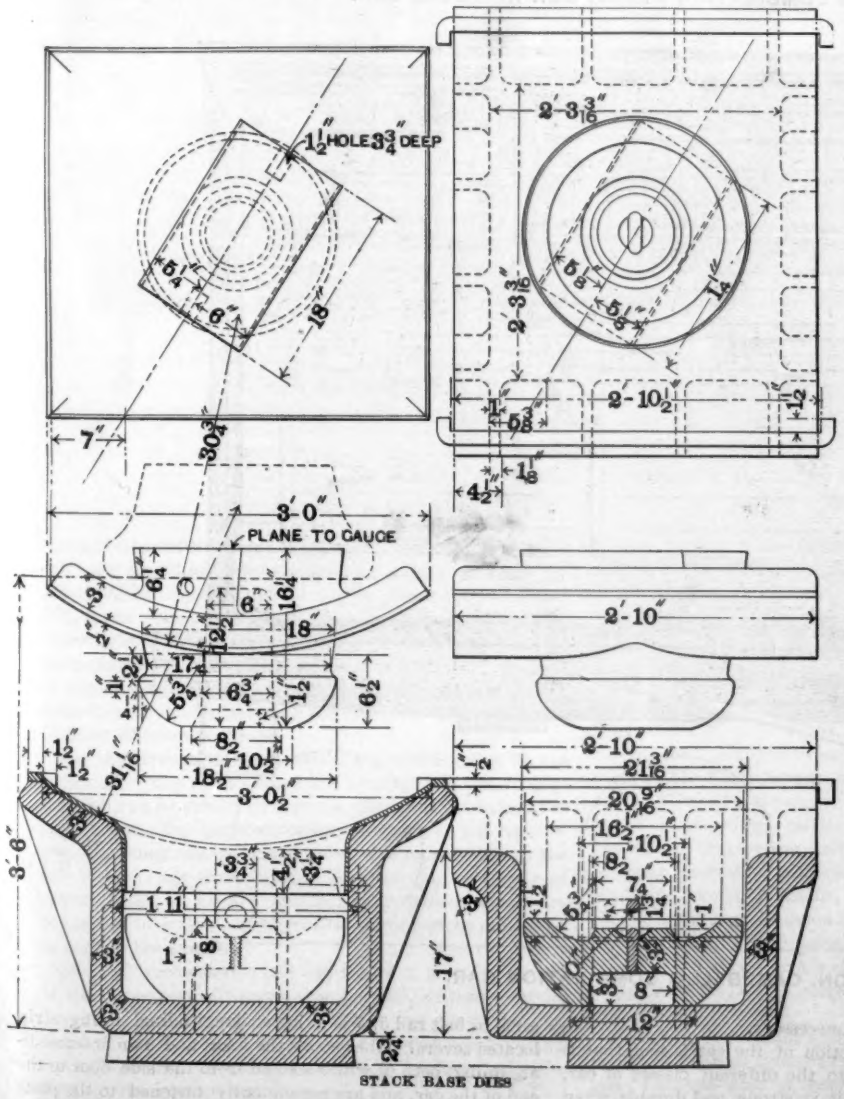
Kind of fuel to be used	Bituminous coal
Weight on drivers	78,000 lbs.
" " truck wheels	47,600 lbs.
" total	125,600 lbs.
Wheel base, total, of engine	23 ft. 7 in.
" " driving	8 ft. 6 in.
" " total (engine and tender)	47 ft. 6 in.
Height, center of boiler above rails	8 ft. 8 in.
" of stack " "	14 ft. 11 in.
Heating surface, firebox	159.3 sq. ft.
" " tubes	1,715.6 sq. ft.
" " firebrick tubes	28.8 sq. ft.
" " total	1,903.7 sq. ft.
Grate area	26.96 sq. ft.
Drivers, diameter	75 in.
" material of centers	Cast steel
Truck wheels, diameter	36 in.
Journals, driving axle, size	8 in. dia. × 11 in. long
" truck " "	6 in. dia. × 10 in. long
Main crank pin, size, main rod 5½ in. × 5½ in; side rod, 4½ in. dia. × 4 in. long.	
Cylinders, diameter	19 in.
Piston, stroke	24 in.
" rod, diameter	3½ in.
Kind of piston rod packing	Jerome metallic
Main rod, length center to center	7 ft. 7½ in.
Steam ports, length	20 in.
" " width	1⅝ in.
Exhaust ports, length	20 in.
" " width	3 in.
Bridge, width	1⅝ in.

Valves, kind of	Allen-Richardson Balanced
" greatest travel	6 in.
" outside lap	1¼ in.
" inside clearance	⅛ in.
" lead	⅛-in. lap in full gear forward motion and back eccentric set to give ¼ in. lead at 6-in. cut-off forward motion.
Boiler, type of	Extended wagon top
" working steam pressure	190 lbs.
" material in barrel	Carbon steel
" thickness of material in barrel	⅞, ⅝, 11/16 in.
" diameter of barrel at first ring	62 in.
Seams, kind of horizontal	Multiple riveted, butt with welt inside and outside
" " circumferential	Double riveted
Thickness of tube sheets	½ in.
" of crown sheet	⅝ in.
Crown sheet stayed with	Radial stays 1 in. diameter
Dome, diameter	30 in.
Tubes, number	287
" material	Syracuse iron No. 11
" outside diameter	2 in.
" length over sheets	11 ft. 6 in.
Firebox, length	8 ft. ⅞ in.
" width	3 ft. 4⅝ in.
" depth front	77¼ in.
" " back	65¼ in.
" material	Shoenberger steel
" thickness of sheets	Back and sides, ⅞ in.
" brick arch? Yes	Supported on four 3-in. tubes
" water space, width	Front, 4½ to 5 in.; sides, 4 to 4½ in.; back, 4 in.
Grate, kind of	Rocking, with drop plate
Smokebox, diameter outside	65 in.
" length from flue sheet	66¼ in.
Exhaust nozzle, single or double	Single
" " diameter	4¾ in., 5 in. and 5¼ in.
" " distance of tip below center of boiler	15⅝ in.
Netting, wire or plate	Perforated plate
" size of perforation	1½ in. by ⅞ in.
Stack, straight or taper	Cast iron, taper
" least diameter	Near bottom, 14 in.
" greatest diameter	At top, 16¼ in.
" height above smokebox	3 ft. 6¼ in

Special Shop Tools.

Stack Base Dies.

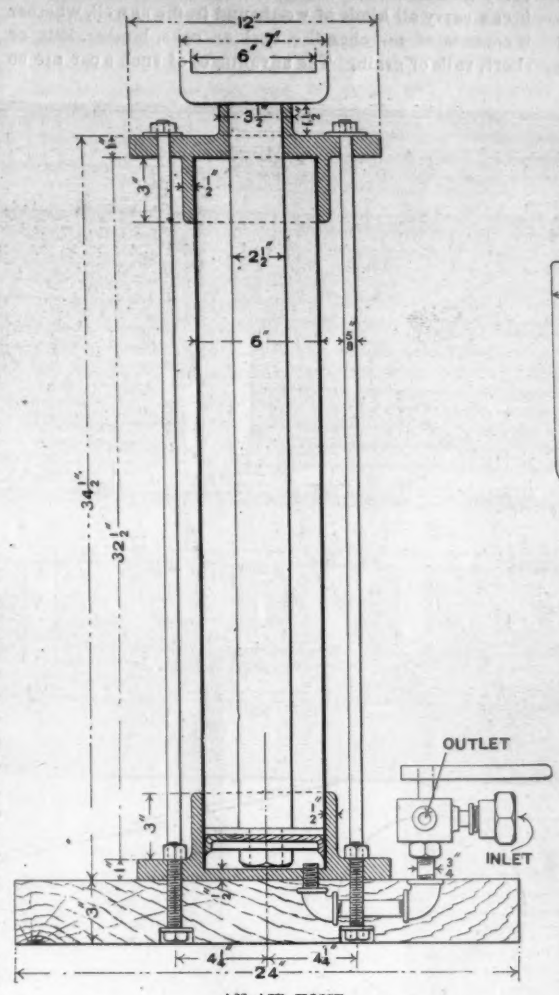
Among the many other special tools that have been made and are in use in the shops of the Philadelphia & Reading Railroad at Reading, Pa., are the dies that are used under the steam hammer for stamping out the bases for the smoke-stacks. The one illustrated is that used for stamping the bases for 20 inch stacks. It will be seen to consist of a cast-iron matrix finished to the curve and outside diameter of the base. This is keyed to the anvil, while the stamp is keyed to the hammer head as indicated by the center figure on the left. The process is exceedingly simple, the heated plate is put over the matrix, and the head coming down forces it into shape. It is the impression of many that hydraulic pressure is alone suited for this class of work, but it is a mistake. A wide range of stamping and pressing can best be done with the steam hammer. The Schoen Manufacturing Co., for example, stamp out all of its center plates under the hammer, and do it with a rapidity that could not be approached by the hydraulic press. The same statement holds good with regard to these stack bases. As the dimensions are so fully given upon the engraving, any recapitulation of them is unnecessary.



STACK BASE DIES

An Air Hoist.

The hoist of which an engraving is here given is one that is in use in the West Albany shops of the New York Central & Hudson River Railroad for raising driving-boxes in the jaws. It is formed of a piece of 6-inch brass tubing set in castings at each end, and which form the top and bottom. They are held together by four ⅝-inch bolts. The piston rod is a bar 2½ inches in diameter with a ½-inch plate and a cup-packing bolted to the lower end. At the top there is a casting having a shape suitable for holding the boxes.



AN AIR HOIST.

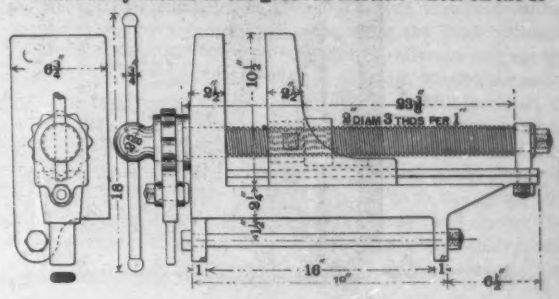
The whole is bolted to a 3-inch plank, having a passageway cut out on one side for a ¼-inch air pipe leading into the bottom of the cylinder from a three-way valve of simple construction, that has, on the inlet side, a screw connection for making the attachment to the main air-pipes running from the compressor.

A Spring Vise.

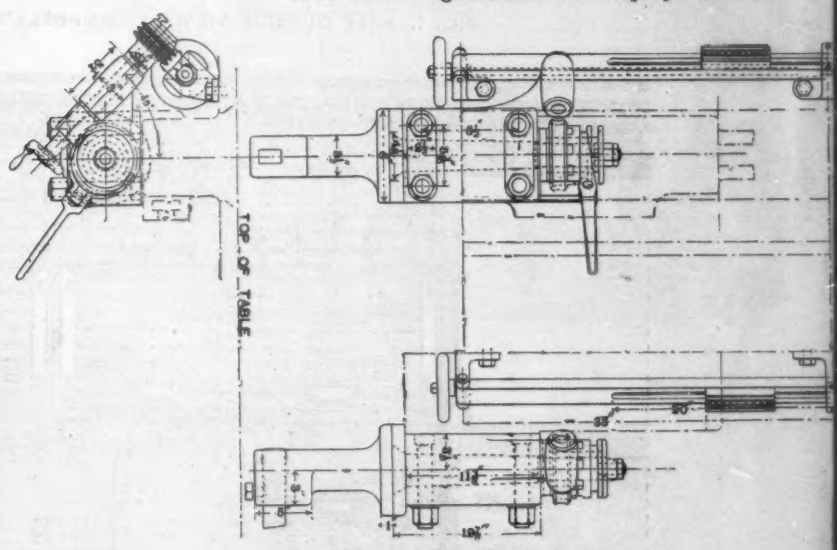
This is not a vise that is operated by a spring, but is designed to hold the leaves of plate springs while the band is being shrunk on. This is also in use in the Reading shops of the Philadelphia and Reading Railroad. Its construction as well as its principal dimensions are clearly shown by the engravings. It consists of a strong frame that includes one jaw and is rigidly bolted to a heavy block set in the floor. The screw is two inches in diameter and is fixed while the movable jaw with its nut moves over it. This jaw can be rapidly run up by the hand lever in the usual way and the final tightening secured by the ratchet lever to which a long handle can be attached. It is simple, strong, cheap, rapid in action and home-made.

Attachment for Slotting Boxes.

Here is another from the same Reading shops that are so rich in special contrivances. This is especially designed for slotting the curved face in driving-boxes, the tool is carried at the lower end of a spindle that is fitted, at the upper end, with a clutch engaging a worm gear. This worm gear meshes with a worm on the spindle shown in the plan as standing at an angle of 45 degrees with the center line of the machine. After the box is brought to a central position with the cutting spindle the tool can evidently be given a circular feed by turning a hand-wheel on the 45-degree spindle. The power feed is obtained by means of the grooved friction wheel on the 45-degree spindle. This rises and falls with the tool. On the vertical screw attached to the frame and which is clearly shown in the side and front elevations, there is, what might be called a friction rack. This can be raised and lowered by the vertical screw just alluded to and its position is such that the friction wheel runs into it on the rise, turns the 45-degree spindle and thus feeds the tool. As the friction contact is lowered the wheel moves over it for a greater distance and the feed is increased. As it is raised the feed is lessened, and it is stopped by slackening the frictional contact of the feed wheel.



A SPRING VISE.



ATTACHMENT FOR SLOTTING BOXES.

Sleeping Car Rates.

As we announced in our last issue, agitation has been going on for some time looking to a reduction of sleeping car rates, and specially to a reduced rate for upper berths. About the best exposition of the folly of the plan are the following remarks on the subject recently made by an officer of the Wagner Palace Car Company. He said:

"I say unqualifiedly that the sole practical result in doing this would be a net reduction in our earnings of about 20 per cent. with no advantage to the railroad company operating our cars, and practically no advantage to the traveling public. The rate for an upper berth between New York and Boston is $1, but the lower berths at $1.50 are invariably sold first. We have sleeping car tickets on sale in the same offices where the Boston and New York tickets are sold, and agents inform me that passengers are just as anxious to secure lower berths in the New York cars at a higher price than is charged for the upper, as they are to procure the lower berths in our sleepers on runs where the price of the uppers and lowers is the same. I feel certain that any one who gives the subject careful consideration must be convinced that an attempt to establish first and second-class rates in a sleeping-car would not be successful, or appreciated by the traveling public. The ordinary traveling man is keen to secure a reduction in railroad rates that does not make a second-class passenger of him but the reduction in the price of upper berths would have, in my judgment, an entirely different effect. A passenger now buys an upper berth when the lowers are sold, on the basis of first come first served, and there is no question of caste, or first or second-class rates about the transaction. My experience warrants me in the belief that 99 passengers out of 100 would be in no way influenced by the fact of an upper berth being sold at a lower rate, while, on the contrary, I believe that in many cases it would absolutely deter passengers from buying upper berths, on the ground that they would not want to be regarded as going in for something cheaper than their neighbors in lower berths."

Campbell's Combination Freight Car.

In its last March issue, the NATIONAL CAR AND LOCOMOTIVE BUILDER published a brief general description of the combined stock, box and coal car designed in accordance with the suggestions of Mr. Robert B. Campbell, General Manager of the Baltimore & Ohio Railroad, and Mr. Howard Carlton, many of which are now in use on that road. We now present a more detailed description of this useful type of car than we then published, together with superior illustrations, which we are sure will prove of further interest to the readers of the NATIONAL CAR AND LOCOMOTIVE BUILDER while at the same time presenting much entirely new information to the readers of the AMERICAN ENGINEER AND RAILROAD JOURNAL, which papers are consolidated in this issue.

The main object sought in the construction of this type is to provide cars that can always carry a useful and paying load in which ever direction they run. The live stock traffic of the Baltimore & Ohio is very considerable, but it is nearly all an eastbound traffic. During the return trip to the West the cars are generally hauled empty, as they are unfitted for most kinds of westbound freight. Of course this haul is a dead loss, and it is to avoid such loss that this combination car has been designed. It can carry the eastbound live stock traffic most admirably, and it can carry all kinds of westbound traffic as well, whether it consists of merchandise, coal or coke, lumber, long or short, rails or grain. The advantages of such a car are so obvious that comment is unnecessary.

The mechanical construction of the car is such that it can be readily changed into the different classes of car, and is so constructed that it is strong and durable when used for any class of freight, and it is not an expensive car to keep in repair.

Fig. 1 is a view showing one-half of the outside of a car of this kind; Fig. 2, a longitudinal section; Fig. 3, an end view, and Fig. 4 a transverse section.

The sides of the car are of an ordinary form of construction, as shown in Fig. 1. The figure 1 designates the vertical posts by which the sills, 29, and plates are joined; 2, diagonal braces; 3, shut posts; 4, shut braces; and 5, a belt rail. Hooked straining rods are used in connection with these and constitute what is called a "bastard" Howe truss.

On the right hand side of the sectional view, (Fig. 4), a lining strip, 6, is shown, which is securely and permanently attached to the side frame posts, braces, and also to the girth or belt rail 5; 7 is a lower longitudinal lining strip located several inches above the floor, and 8 an intermediate lining, both of which extend from the side door to the end of the car, and are permanently fastened to the posts and braces. An upper longitudinal-tongued and grooved lining, 9, covers approximately one-half the area of the space between the girth and pate, and is permanently secured to the posts and braces. What is called the "lower adjustable side," consists of two panels or slots, 19

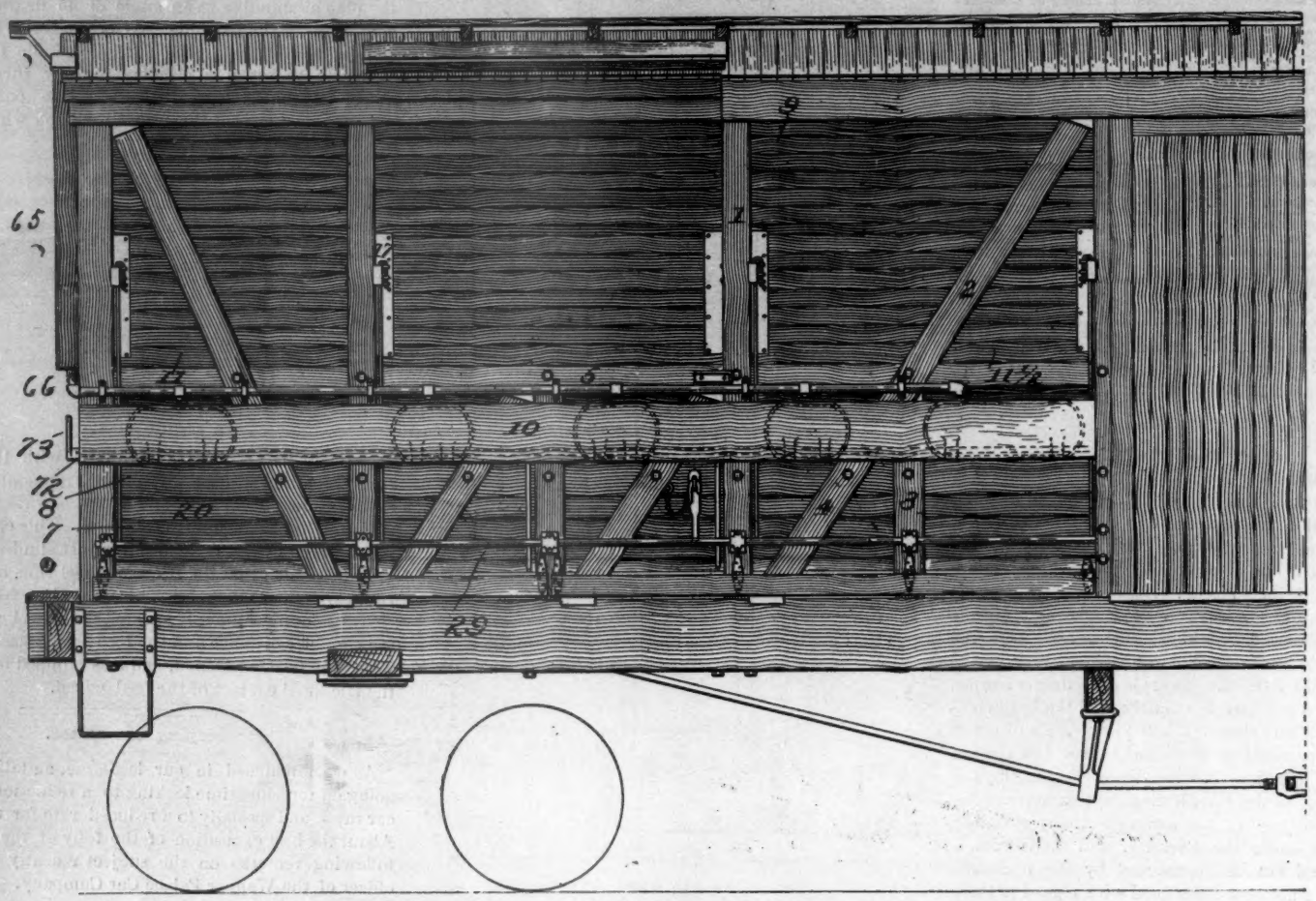


FIG. 1. HALF OUTSIDE VIEW OF CAMPBELL'S COMBINATION STOCK, BOX AND COAL CAR.

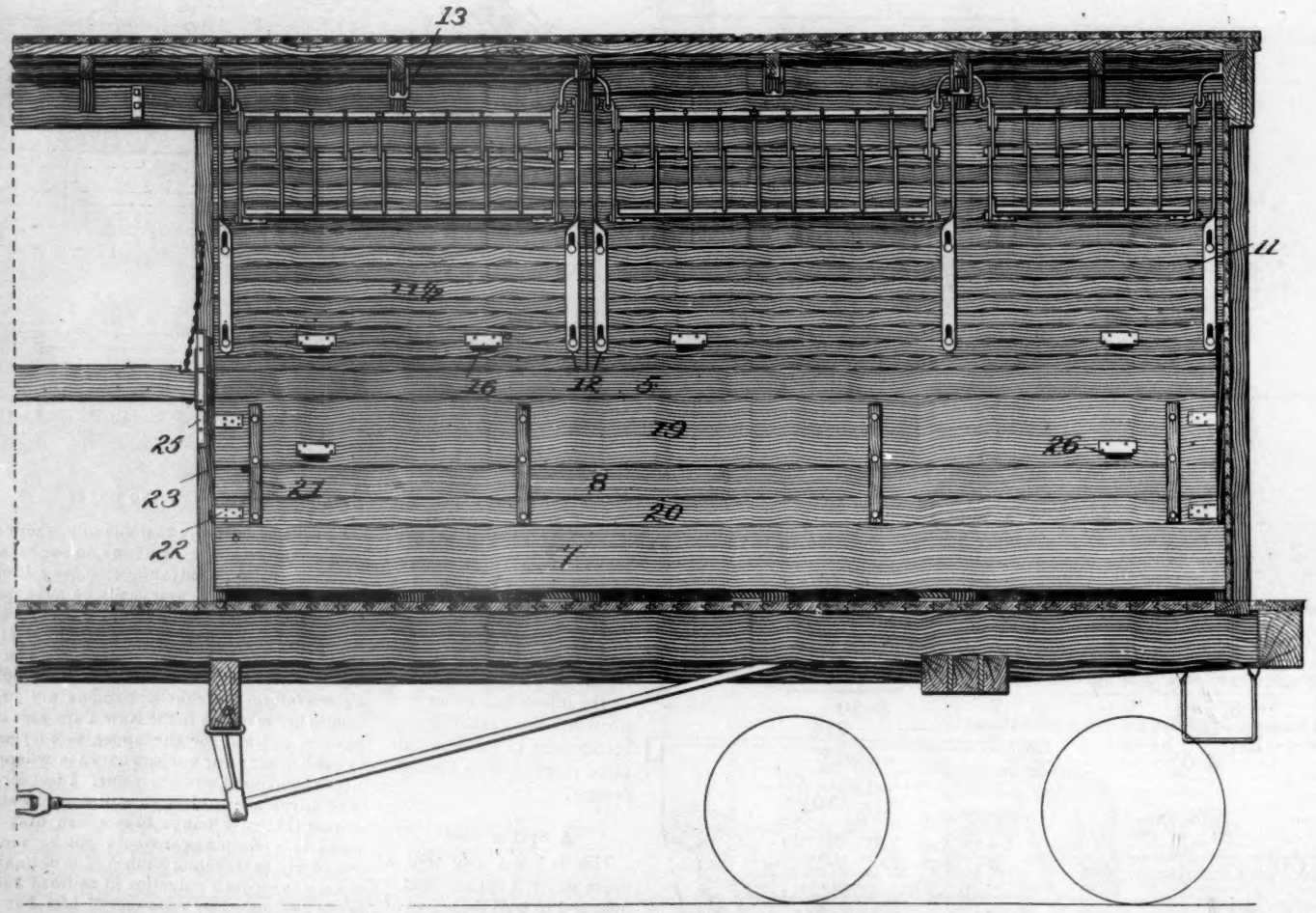


FIG. 2. HALF LONGITUDINAL SECTION, CAMPBELL'S COMBINATION CAR.

and 20, and is shown in its upper position on the right-hand side of Fig. 4. These slats are fastened together by iron cleats, 21. The edges of the slats and also those of the strips 6, 7 and 8 are made of an ogee form, so that they will engage with each other. This adjustable side is made removable, and can be fastened in the position in which it is shown on the right-hand side of Fig. 4, or it can be taken down and put in the position in which the slats 19 and 20 are shown on the left-hand side of Fig. 4. When it is in the former position, there are open spaces between the lining, 9, slats 19, 20, 6, 8 and 7, and the car is then adapted for carrying cattle.

If it was desirable to load it with coke or coal, the adjustable side 19 and 20 would be unfastened and removed from the position in which it is shown on the right of Fig. 4, and placed in that shown on the left side of the same figure, thus closing up the spaces between the slats 6, 8 and 7, and leaving that between the lining 9 and the belt rail open for loading the car. After it is loaded with this or other kinds of freight it is desirable to close this space. To do this, what are called the "upper adjustable sides" are provided. These consist of tongued and grooved paneling, 11, which is fastened to wrought-iron cleats or hangers, 12, which are pivotally connected to the rafters at *a*. By this means the paneling can be raised up against the roof, in the position shown on the right of Fig. 4, or when the slats, 19 and 20, are removed from their upper position it can be lowered into the position in which it is shown on the left of Fig. 4. It thus closes the opening

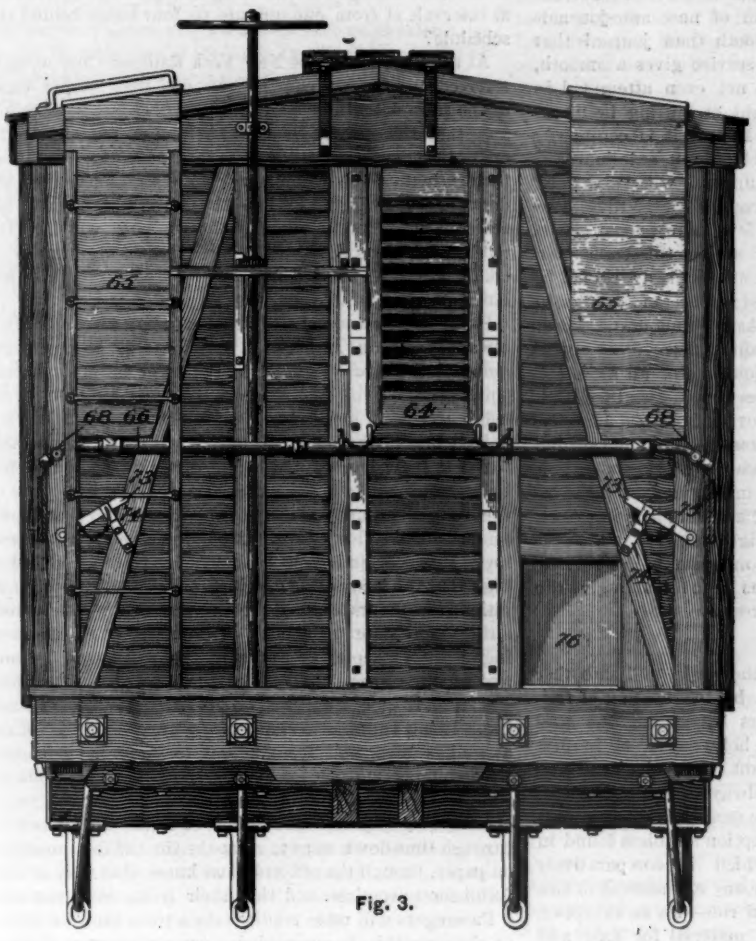


Fig. 3.

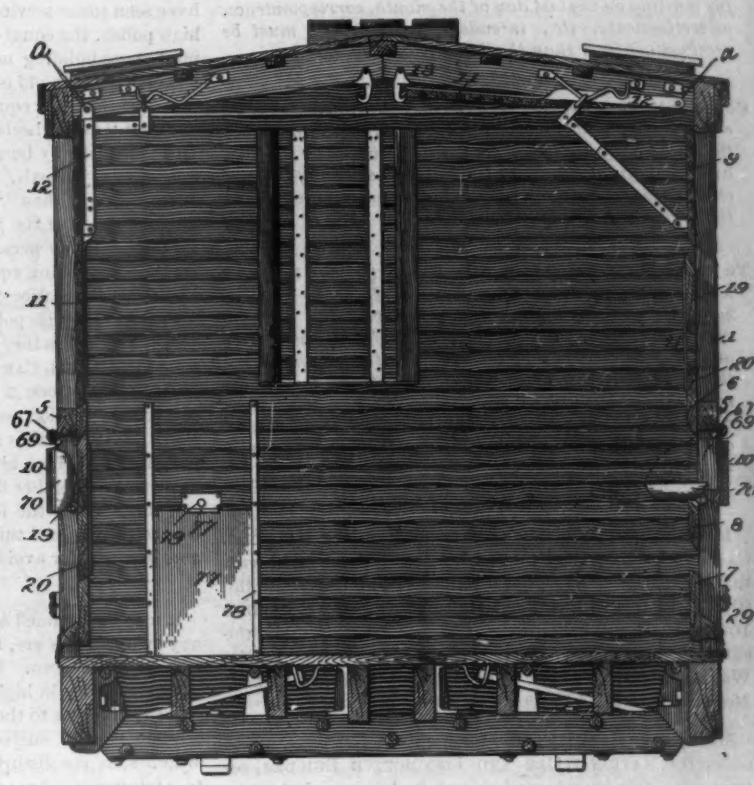


Fig. 4.

END VIEW AND TRANSVERSE SECTION, CAMPBELL'S COMBINATION FREIGHT CAR.

completely, and its ogee-shaped edges make a tight joint with the adjoining slats. It will be seen that when the lower adjustable side is in the position shown on the left of Fig. 4 the whole side of the car is closed, and is made watertight by means of the ogee edges of the slats, and it is thus adapted for carrying merchandise freight. A number of ingenious devices have been provided for making this transformation and fastening the different parts securely in their different positions.

For the transportation of cattle, hinged troughs, 70, are provided, which are attached to a longitudinal rod, 72, Fig. 1 which can be turned by a crank, 73, so as to bring the troughs into the position for use as shown on the right of Fig. 4, or they can be turned upward as represented on the left side of this same figure. For carrying a supply of water, tanks, 65, Figs. 1 and 3, are provided which are connected by suitable pipes so that water can be delivered to each of the troughs.

Iron hay racks shown in Figs. 2 and 4 are also placed in the upper part of the car near the roof, with doors in the latter for supplying the racks. Ventilating doors, 64, Fig. 4, are placed in the ends of the car and also small sliding doors, 76, at opposite oblique corners for loading steel rails, long timber, lumber, etc.

Such a car can be used in carrying one class of freight in one direction and another class in the opposite direction, thereby, it is evident, enabling the transportation companies to reduce the empty haulage of their cars to a minimum and to practically double the carrying capacity of their common freight cars.

Pennsylvania Railroads.

Major Isaac B. Brown, Superintendent of the Bureau of Railways in the Department of Internal Affairs, of Pennsylvania, has prepared an interesting chapter for the forthcoming report of the Department, on the cost of railroads and equipment in that State.

An examination of the figures given shows that in the prosperous days of 1890, 1891 and 1892 there was a great increase made in the cost of roads and equipment. From 1890 to 1891 there were more than one hundred million dollars added to the cost of roads and equipment, and from 1891 to 1892, more than ninety millions. Here the tide changed and the annual percentage of increase in each of the three following years was very small compared with the years 1890 to 1891 and 1891 to 1892. From 1892 to 1893 the increase was about sixteen millions; from 1893 to 1894 about nineteen millions, and from 1894 to the close of the fiscal year, covered by this report, $41,355,800.

There are eight great railway corporations whose cost of road equipment is given at more than $50,000,000. These roads are the New York, Pennsylvania & Ohio, New York, Lake Erie & Western, Pennsylvania, Philadelphia & Reading, Pittsburg, Cincinnati, Chicago & St. Louis, Lake Shore & Michigan Southern, Western New York & Pennsylvania, Pittsburg, Fort Wayne & Chicago.

From the figures given by these corporations it is found that the average cost of road and equipment per mile of road has been as follows:

New York, Pennsylvania & Ohio	$396,988
Lake Shore & Michigan Southern	97,771
New York, Lake Erie & Western	302,396
Pennsylvania	213,705
Philadelphia & Reading	336,001
Pittsburg, Cincinnati, Chicago & St. Louis	85,861
Western New York & Pennsylvania	81,169
Pittsburg, Fort Wayne & Chicago	106,773

It is true that the railways of Pennsylvania have a greater capitalization, or show a greater cost per mile of road, than those of most other States, but there are cogent reasons for this apparent excessive cost. First, there is no State in the Union whose railways are so generally on the advance line of protection; and, second, there is no State in the Union where railway construction has been more expensive. Traversing and tunneling great mountains, bridging numerous and broad rivers, constructing double, triple and quadruple tracks, together with the expenditure of extraordinary amounts for the rights of way in rich farming regions and numerous municipalities, and the securing of the best terminal facilities, have made the railways of Pennsylvania show an exceedingly high rate of cost per mile of road.

No person conversant with the cost of railway equipment and railway construction can fail to observe the almost limitless cost of constructing and equipping the Pennsylvania Railroad. Its equipment is superb, and is always maintained in the most improved, substantial and perfect manner; its roadbed is perfect, and its stone and iron bridges are the best product of engineering skill. The design of the company seems to be to conserve the convenience, safety and comfort of its patrons. All these things have made the cost and equipment of the Pennsylvania road the high figure given above, but the security holders, the patrons and the citizens of Pennsylvania generally have the satisfaction of knowing that, although the cost has been enormously large, the "Pennsylvania" is acknowledged, both in Europe and America, to be the most perfect railway organization on the globe.

The extraordinary expenses that have made the Pennsylvania road cost so much per mile will apply in a great degree to other Pennsylvania companies. It cannot, however, be claimed that these causes have produced the high mileage cost of the New York, Pennsylvania & Ohio. Its line of road is through a territory where right of way was generally inexpensive, and it is but a single track line. It had no mountains to traverse, no great rivers to bridge, no expensive municipalities to deal with, and it certainly has never been burdened with expensive terminal facilities. Indeed it is hard to account for the high mileage cost of this road. The average cost of railways and equipment in the United States is not far from $63,000 per mile. By comparison with the cost of roads in this section, it will be seen that there is a great disparity. There are some short line roads in Pennsylvania whose average cost per mile is much greater than that of the New York, Pennsylvania & Ohio. This is due in most cases to the great expense incurred in procuring rights of way, and also to the fact that but little or no part of the line is inexpensive, and there is therefore no chance of reducing the average. For instance, the cost of construction alone of the Connecting Railroad is given as $509,805; the Ohio Connecting, $403,669; the Schuylkill River East Side, $818,181.

The cost of the Philadelphia & Reading Terminal, which includes the expenditure for one of the most magnificent and expensive stations in the world, and for the right of way through the city of Philadelphia, is reported as $7,926,031 per mile. This road is only a little over a mile in length. There are, however, only a few roads that have so high a degree of cost per mile.

An Extended Use of Copper.

Attention has often been called to the increase in the demand for copper, caused by the extension of electrical work in various directions. An instance of a new demand for the metal is found in the recently issued annual report of the Western Union Telegraph Company. The company, during the year ending with June last, added to its wire lines a net length of 11,859 miles, and over 10,000 miles of the new wire are of copper. The report states also that the company has adopted the policy of replacing all defective iron wires on its line with copper, the intention being to use that material alone on all the principal lines hereafter. The advantages of saving in weight, increased capacity for electrical transmission and diminished liability to interruption from atmospheric conditions are sufficient to make the copper wires more economical in the end, notwithstanding their greater first cost.

(Established 1832.)

AMERICAN ENGINEER

CAR BUILDER AND RAILROAD JOURNAL.

27TH YEAR. 65TH YEAR.

PUBLISHED MONTHLY
BY
R. M. VAN ARSDALE,
MORSE BUILDING.....NEW YORK.

GEORGE H. BAKER, Editor.

HERBERT W. POOL, Business Manager.

JANUARY, 1896.

Subscription.—*$2.00 a year for the United States and Canada; $2.50 a year to Foreign Countries embraced in the Universal Postal Union.*

EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Special Notice.—*As the* AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL *is printed and ready for mailing on the last day of the month, correspondence, advertisements, etc., intended for insertion must be received not later than the 25th day of each month.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.* **When a subscriber changes his address** *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

ANNOUNCEMENT OF CONSOLIDATION.

In the present number of this publication the NATIONAL CAR AND LOCOMOTIVE BUILDER has been consolidated with the AMERICAN ENGINEER AND RAILROAD JOURNAL, with the title of AMERICAN ENGINEER CAR BUILDER AND RAILROAD JOURNAL. It will hereafter be published monthly under the editorial supervision of Mr. M. N. Forney, assisted by Mr. Waldo H. Marshall, heretofore editor of the *Railway Master Mechanic*, published in Chicago.

Mr. George H. Baker, who for the past four years has edited the NATIONAL CAR AND LOCOMOTIVE BUILDER, retires when this issue is mailed, and in doing so desires to express to each reader his appreciation of the support and courteous treatment he has uniformly received at the hands of the patrons of the paper. His thanks are specially due and are most sincerely tendered to the railroad officers in all parts of the country, who by their kindly help aided him in making the NATIONAL CAR AND LOCOMOTIVE BUILDER interesting and instructive to its readers. He came to the editorial chair from practical railroad work with high esteem for the sincerity, integrity and progressiveness of American railroad officers, and he retires with this sentiment strengthened and enhanced beyond question. No class of Americans excel in the possession, in high degree, of the first-named qualities, and the superior efficiency of American railroads and their equipment (especially their rolling equipment) to that of the railroads of the world, proves their progressiveness.

Sincerity and integrity of purpose are chief among the foundation principles of right living and of civilization. Progressiveness is the motor of civilization, conveying us always to better things in every walk of life. It is the spirit of Wordsworth's "Happy Warrior,"

> "Who, not content that former worth stands fast,
> Looks forward, persevering to the last
> From well to better—daily self surpassed."

It is the province of the technical railroad papers to promote this quality and herald its achievements; and in doing this they have done, and are doing, a work of incalculable advantage to railroad interests, to railroad men, and to the patrons of these leaders as well as servants of civilization. During its 26 years of existence the NATIONAL CAR AND LOCOMOTIVE BUILDER stood second to none in the quality and success of its efforts to fulfill its mission, within its scope, as indicated above; and during its last four years it was specially successful in promoting safer methods of passenger car construction, greater care of locomotive boilers, and the adoption of improvements looking to the more economical operating of locomotives.

REDUCING JOURNAL-BOX FRICTION.

The resistance of trains to being hauled constitutes the work that locomotives in overcoming it must perform. Any increase in this resistance is a tax upon locomotives, and any decrease in such resistance enables locomotives to perform more useful work (haul more cars or make better time) with the same expenditure of power. It is therefore evident that efforts to decrease train resistance are in the line of economy and greater efficiency. Train resistance is really made up of several "resistances," or it has several elements, such as the resistance of the air, the rolling friction of the wheels on the rails, journal-box friction and the inertia of the load. Probably the most susceptible to reduction of all these is journal-box friction. In cold weather this friction is greatly increased because of the vicosity of the congealed oil. We treated this matter at some length in the last (December, 1895) issue of the NATIONAL CAR AND LOCOMOTIVE BUILDER, and will not go into it again here further than to say that carefully conducted railroad laboratory tests have demonstrated that with a fall of temperature of 70 degrees the friction was doubled with the same oil. Dilution, preferably with kerosene, to a fluid consistency in actual service is the best remedy for this evil.

Our present purpose is to call attention to another possible means of reducing journal-box friction, and this is by giving to new axle-journals a smoother finish than is generally done before they are put in service. Persons familiar with the usual condition of new axle-journals know that they are much less smooth than journals that have seen some service. Actual service gives a smooth, high polish, the equal of which is not even attempted in most shops building new equipment or putting in "new wheels" beneath old equipment. In fact, it is commonly expected that new equipment will have hot axle-journals, and that "new wheels" in old equipment will "run hot." This is principally because of the commonly too rough surface of new journals. There are few more potent causes of train delays than "hot boxes," and in this connection the experience of the Missouri Pacific Railway should be valuable to every person interested in the most efficient operation of rolling equipment. As we announced a year ago, it is the practice of the mechanical department of this road to give a high polish to the journals of all axles and crank pins before they are put in service, and we then illustrated (NATIONAL CAR AND LOCOMOTIVE BUILDER, January, 1895, and described a tempered steel roller of cheap and simple construction used for burnishing the journals. This roller burnisher takes no metal from the journal, but compresses the surface about .002 of an inch, and imparts a harder and smoother finish, and higher gloss than we ever saw imparted by the longest and most successful service. On the road named this methad has been found to give the *sine qua non* for avoiding hot boxes.

It may be assumed as true that the harder and smoother any two surfaces are, the less will be the amount of friction between them. Watchmakers know that fine steel pivots, running in highly polished holes cut in the hardest jewels, give rise to the least amount of friction, and consequently such surfaces are always chosen for fine watches, as the disturbance of the motion is thus reduced to a minimum. An apparent exception to this is found in the case of Babbitt metal, which is comparatively soft. We do not attempt to offer any explanation of this apparent exception to the general rule—for an exception it certainly is. In selecting the material for axle and crank-pin journals it is important that the material be hard and close-grained. Open-grained surfaces will begin to cut sooner or later, and when once this action fairly sets in it is almost impossible to stop it. Where wrought-iron is used, it is important that the fibers of the bar of which the axle is made be thoroughly welded together. If they be left in a loose and fibrous condition, and the direction of the motion be at right angles to the direction in which the fibers run, it will be impossible to produce a smooth-running journal.

One of the greatest benefits conferred upon mechanics by the modern improvements in the manufacture of steel and iron is the introduction of a hard, non-fibrous material for journals. Common steel, good enough for all purposes except the making of fine edge-tools, can now be had at a very moderate price, and wherever a journal is required to give the best satisfaction, it should be made of steel.

In finishing the surfaces of journals, great care ought to be taken to avoid the use of emery. It is wonderful how readily the hard-cutting grains of emery and similar polishing substances become imbedded in iron, brass and other materials, and then act just like diamond drills. Every watchmaker knows that a copper wheel or disk smeared with diamond-dust will rapidly cut the hardest steel, and the action is the same in regard to all metal surfaces to which emery has been applied with considerable force, as in the ordinary process of polishing. Smoothness is an essential requisite in all surfaces that slide or roll one upon the other, but this smoothness ought in all cases to be attained by burnishing in the manner described, or by cutting with sharp steel tools, and not by polishing with grinding substances.

PASSENGER TRAIN DETENTIONS.

If there is one thing that the average traveler appreciates more highly than anything else, even placing it above comfort and safety, to say nothing of the luxuries of the limited express, it is the certainty that the train upon which he is journeying will arrive at its destination on time. Perhaps this is valued more highly in this country than elsewhere on account of the rarity of its attainment, for when a railroad officer asserts, as was done at the New York Railroad Club the other evening, that the result of an investigation of carefully compiled statistics leads to the conclusion that upon a great trunk line, provided with every facility for the moving of its trains, 34 per cent. of them are late, the general public is apt to think that a much higher average prevails on the majority of roads, even though it may not quite touch the point given by one speaker, where, out of some 275 trains used by him on a certain road between April and January, only one was on time, and that one, to put it in the form of an Hibernianism, was a minute late.

But whether the average is thirty-four or one hundred per cent. it is very certain that the proportion of trains arriving at destination behind time is very much greater than it should be, and certainly so far as our own personal observation goes, is very much greater than it is in European countries. If this is so, then our Yankee smartness seems to be of no avail, for what does it really profit the country that we run one train the fastest in the world if the other ninety and nine drag along into the terminals at intervals of from one minute to four hours behind the schedule?

At the meeting of the New York Railroad Club already referred to, it was shown that less than 11 per cent. of the train detentions were due to failures of equipment, and that the remainder can be laid at the door of the operating department. But to the passenger it matters little whether the locomotive looses a crank pin or the dispatcher his wits, so long as the train fails to carry out the contract virtually made by the company when, by the publication of its timetable, it promises to the traveler on train 10 that he shall reach A at 10:30 a. m., but does not land him there until noon.

He knows that something is wrong, but what he cannot always determine. Personal observations and personal opinions are always liable to the error of the personal equation and must therefore be carefully weighed before being accepted; and with this preface it seems to us that the great majority of detentions which we have been able to sift to their sources may be referred to as caused either by an overloading of the locomotive or the interference of the freight trains that have blocked the way of the passenger trains. This means bad judgment and bad despaching. It is poor judgment to schedule a train at a speed so high that the locomotive can just make time when all conditions are favorable, and that a slight rain, a head wind, a little more slate in the coal, an excursion of slowly moving country people, or an extra car, will mean a steady loss of time from one end of the division to the other. Yet this is just what we do see in everyday railroading. Roads running to competing points compete on time as well as rates, and from actual observation of accomplished facts we are led to the belief that, in some instances, the less favorably situated road, both with reference to motive power and profile of track, will crowd its through time down so as to meet the time of its competitor on paper, though the officers must know that they cannot fulfill their promises, and that their trains must run late.

Passengers will more readily take a train using 11 hours, on the timetable, to accomplish a certain journey if there is a certainty that 11 hours means 11 hours than they will a train taking 10 hours on paper with an equal certainty that that 10 hours means 10½, and it seems strange that railroad managers are so slow to appreciate this fact. Hence, if trains are overloaded there is but one remedy: apply more power. Either run two sections or double-head; but whatever it may cost, it will be found to pay to get there on time, and the moral of this first lesson is—do not overload the locomotive.

Regarding the second class of detentions, freight trains blocking the track, the first impression is that that means bad despatching, but as it is a general condition on almost every road in the country, whether it be single or double tracked, but especially in the case of the former, so, as the despatchers are men that, as a class, must rank above the average in intelligence and careful application and attention to business, we are led to inquire whether the duties of a despatcher are not beyond the limitations of the human mind to properly execute. When we know of despatchers issuing 300 orders in a trick of eight hours it appears that it is about time to shorten hours or change the system.

To change the system can mean but one thing and that is the scheduling of freight trains and instead of running them by telegraph, running them by timetable. Why not? The system has been tried and worked for years abroad and it would and should be more of a task to convince a European manager that the telegraph is the proper method of operating freight trains, than it would be to convert an American manager to the use of the schedule system. The one has the merit of success to recommend it. Passenger trains in France and Germany run on time and a careful observation of many hundreds of trains failed to find one that either arrived at destination or

passed intermediate stations behind time. This does not mean that trains are never late, but that one observer has totally failed to catch a train in the act, a condition that no one, in this country, would fail in if the investigations were prolonged through a single half day. With this apparent record at its back and the facts as well known as they seem to be, it seems strange that the system has no foothold in this country. We acknowledge that the work of the compilation of time-table on a single track road doing a heavy business would be immense, but when once done it is at least finished for the season, and the relief to the despatchers would be even greater. To issue 300 orders in eight hours, is to assume responsibilities that are too great to contemplate, and to run risks that come very close to being criminal, and when we consider the actual mental capacity of the average despatcher we are led to a suspicion that the limit of elasticity of his capabilities are very frequently exceeded.

The operating department, stands confessedly convicted of the responsibility for most detentions to passenger trains, and if the majority of those detentions are due, as we believe they are, to the overloading of engines and the interference of freight trains, it certainly does seem that it would be worth while from a business standpoint and for the advantages that would certainly follow the reputation of running trains on time, to make an application of the two remedies that we have indicated and which have worked so well and produced such markedly good results on foreign railroads.

The series of articles begun in this issue on the Construction and Maintenance of Railway Car Equipment will extend through several months, and will doubtless prove of much practical interest to those connected with the construction and repair of cars. The author of the articles is Mr. Oscar Antz, General Foreman of the car shops of the Lake Shore & Michigan Southern Railway at Cleveland, O. Mr. Antz is a member of the American Railway Master Mechanics' Association. He graduated at the Stevens Institute of Technology in 1878, and obtained considerable practical experience in the Meadows shops of the Pennsylvania Railroad, and worked through different grades, including the shop and drafting room. He was then made General Foreman of the South Amboy shops, which position he held for three years, and afterward was Assistant Master Mechanic of the Meadows shops for three years. From the latter position he resigned to become Division Master Mechanic of the Central Railroad of Georgia, which position he held for two years.

Proposed Michigan Central Bridge at Detroit.

The Michigan Central Railroad has decided to erect a high bridge of three spans to cross the river at Detroit that connects Lakes Erie and Huron, and a bill has been introduced in Congress to provide for its erection. The main channel spanis to be not less than 1,100 feet in clear width between the masonry piers, of which there are to be only two, and the clear head-room for vessels under the spans is not to be less than 140 feet. The probable cost of the structure is estimated at $4,000,000.

The Michigan Central has long enjoyed the reputation of being unsparing in its efforts to please its patrons. The decision to build this bridge is another illustration of this predominant spirit. The passage of the Detroit River by ferry has always caused considerable loss of time and unpleasant switching. A bridge will remedy this, and prove an added attraction for travelers for this already exceedingly pleasant route.

Oil Fuel in the Navy.

The recently issued report of the Bureau of Steam Engineering to the Secretary of the Navy states that:

"By reason of our ability to secure a large supply of this combustible, a series of experiments should be made with petroleum to find out its value for torpedo boats and the smaller types of vessels. In order to make these experiments of any value they would have to be long continued in order that the various burners might not only be tested for efficiency but also for endurance. One of the gunboats now building at Newport News would be an admirable vessel for testing the merits of liquid fuel. The tests should not only be progressive but they should be varied. One of the particular questions to be determined would be how much increased power over that furnished by natural draft could be secured by burning the liquid in conjunction with coal. Another important question that might be solved would be the effect of the various fuels on the ends of the tubes. It is safe to say that valuable aid would be rendered by those interested in the development of the oil industry, and an opportunity has now occurred when the value of liquid fuel for naval purposes can be definitely determined."

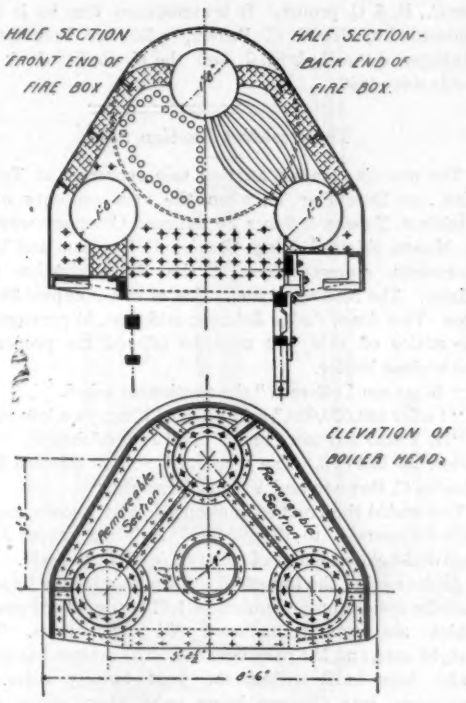
A Locomotive Water-Tube Boiler.

During the discussion of Mr. J. Snowden Bell's paper on Wide Fireboxes for Locomotives" at the November meeting of the Western Railway Club, Mr. William Forsyth, Mechanical Engineer of the C., B. & Q. R. R., suggested the use of water tube boilers for locomotives to increase the possible heating surface without resorting to excessive boiler weight. The accompanying engraving reproduces drawings that show the proposed plan of such a boiler. In speaking of the matter Mr. Forsyth said:

"Mr. Bell says that in making boilers attention has principally been paid to enlarged heating surface, which is obtained largely through the tubes; the heating surface has not grown in proportion to the larger grate surface. In the Wootten boilers, which are so wide, the heating surface, to absorb the large amount to be burned on this grate, ha not increased nearly as rapidly as the grate has increased. Now, in getting large capacity in a locomotive, we have, I think, nearly reached the limit to which we can go in a production of steam with these large boilers without enormously increasing the weight with the ordinary type of locomotive boiler.

"Recently Mr. Yarrow, in England, has built some torpedo boat destroyers, in which he has used water-tube boilers. In torpedo boats themselves he first used locomotive boilers, but when a speed service was required of 35 miles an hour he resorted to the use of a water-tube boiler; and they are also used in the various navies of the world where a large capacity is required in a compact space.

"It seems to me that in the development of locomotive boilers requiring much larger steam capacity, that a water-tube boiler might be made to be successful, and I have made a plan of something of that kind, in which I obtained a heating surface in the firebox of 579 square feet, which is from four to five times the heating surface in an ordinary locomotive firebox. In this design also there are no stay-bolts, except in the front leg, and the firebox can be made as the road limits will allow, so that, although that design


HALF SECTION FRONT END OF FIRE BOX
HALF SECTION BACK END OF FIRE BOX.
ELEVATION OF BOILER HEAD.
Removable Section
Removable Section

WATER-TUBE BOILERS FOR LOCOMOTIVES.

as it is may not be entirely practicable for locomotives, yet it meets the requirements of a large grate, of dispensing with staybolts almost entirely, and of providing an increase in heating surface much larger than the grate surface is increased."

Central Railway Club.

The next regular meeting of this Club to be held at the Hotel Iroquois, on Friday, Jan. 10, 1896, will be the annual meeting, at which officers will be elected for the ensuing year. The business session will be followed by a banquet in the evening. The tickets have been fixed at $2 (including one lady), and can be obtained from the secretary, who should be advised not later than Jan. 5, how many seats are desired at the banquet.

The following reports will be considered:

"When Locomotive Boiler Tubes require to be safe ended should the safe end be welded to the tube proper with a lap weld or butt weld, and in what respect is one method preferable to the other? What would be the comparative cost of these two methods?" Committee: J. H. MOORE, J. N. WEAVER.

"Injury caused by the Drippings of Salt Water from Refrigerator Cars to Track Bolts, Trucks, etc." Committee: A. M. WAITT, Chairman; JOHN S. LENTZ, C. J. BUTLER.

Committee on Nominations: A. C. ROBSON, Chairman; LAMOTT AMES, E. A. MILLER, EUGENE CHAMBERLAIN, J. A. CHUBB.

Committee to Arrange Annual Banquet: F. B. GRIFFITH, Chairman; W. H. GARDNER, E. A. BENSON, O. P. LETCHWORTH, HARRY D. VOUGHT.

Discussion will be had on the following:

Master Car Builders' Rules of Interchange, as revised at Pittsburg, by a committee composed of members of railroad clubs.

Topical questions submitted by members.

Exhibits at the Next Conventions.

The next conventions of the Master Car Builders' and Master Mechanics' Association will be held at Congress Hall, Saratoga Springs, N. Y., June 17th to 24th, inclusive.

It is the wish of the Joint Committee of the Associations that a very complete exhibition be made of all goods and devices used in their respective departments, particularly new and improved machinery, and especially air compressors, pneumatic lifts and tools. In order that such may be shown to the best advantage, it has been decided to furnish, free of charge to the exhibitor, steam, compressed air, and power, and it is very desirable that those intending to make an exhibit, apply for space as early as possible. The Standing Committee has contracted with Congress Hall for accommodations for supply men at following rates: Single room, $3 per day; double room, one person, $4 per day; double rooms, two persons each, $3 per day.

Exhibitors may have space reserved by applying to W. C. Ford, Secretary of the Standing Committee of the Supply Men's Association, Room No. 19, No. 29 Broadway, New York City.

A President's Private Car.

A special car for the use of President Stuyvesant Fish, of the Illinois Central Railroad Company, was recently completed and put in service. The car is 69 feet 6 inches long over the sills, and 10 feet 4 inch wide. Hinson combination platforms are used. The windows have double shades, white outside and dark inside. The dining-room is arranged to accommodate 12 persons at the

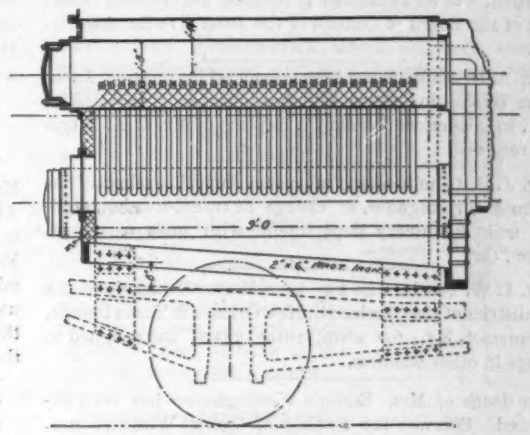


table. There are three staterooms, each with private toilet rooms and dressers, and two of them have upright folding beds.

The inside finish of the car is in polished mahogany except at the rear end, where quarter-sawed oak is used. It is lighted with Pintsch gas, and is also wired for electric lights, electric heating and electric fans. The closets are of the Campbell-House pattern. The washstands and water coolers are white metal, and hammered scrap axles are used, and the trucks have 38-inch Krupp steel-tire wheels.

The Fastest Regular Train.

The New Central & Hudson River Railroad increased the scheduled speed of its Empire State Express on Dec. 4 from an average of 51 miles an hour to 53.33 miles an hour between New York and Buffalo. For more than four years this train has made its daily run of 440 miles in 520 minutes, including four stops and 28 slow-downs. Its new time of 495 minutes is not that of an experimental run, but is scheduled for daily service between New York and Buffalo until a further reduction becomes practicable. The speed of the best trains of foreign nations is: England, 51.75 miles an hour; Germany, 51.35; France, 49.88; Belgium, 45,04; Holland, 44.73; Italy, 42.34; Austria-Hungary, 41.75. America now heads the list with 53.33 miles an hour to the credit of the Empire State Express.

The Pacific Cable Company.

A meeting was held in New York, Dec. 7, to complete the organization of the above-named company. It will lay a cable in the Pacific Ocean to connect San Francisco with the proposed American naval station at Pearl River Harbor, Sandwich Islands, and to Japan, China, Australia and India. It is understood that the contract relations between the Western Union Telegraph Company and the English Atlantic cables expressly provide that the Western Union Company is free to use a Pacific cable route with the countries named, but, aside from this fact, it is asserted, it will be in the interest of all the Atlantic cables to send their messages to the East via this Pacific cable, as it is estimated that more than 90 per cent. of the traffic is European. Thus the establishment of an American Pacific cable will attract to it a large traffic which is now diverted to other lines.

Personal.

Mr. E. C. Osborn has been appointed General Manager of the Poughkeepsie & Eastern.

Mr. A. L. Rives, General Superintendent of the Panama Railroad, has resigned.

Mr. Collis Shanks has resigned the position of General Foreman of the South California shops at Los Angeles, Cal.

Mr. W. E. Symons, Master Mechanic of the Atchison, Topeka & Santa Fe, at Raton, New Mexico, has resigned.

Mr. T. S. Inge has been appointed Master Mechanic of the new Burlington (N. C.) shops of the Southern Railway.

Mr. Charles F. Mayer, President of the Baltimore & Ohio Railroad, has resigned.

Mr. J. W. Karner has been appointed General Manager of the St. Louis, Belleville & Southern, with headquarters at St. Louis.

Mr. G. A. Miller, who has been Acting Master Mechanic of the Florida East Coast Railway, bas been appointed to the position.

Mr. R. L. Herbert has been appointed Master Mechanic of the Southern Pacific at Victoria, Tex., vice Mr. I. R. Garnott, transferred.

Mr. Albert Griggs, Assistant Superintendent of Motive Power of the Chicago & Eastern Illinois Railroad, has resigned and the position has been abolished.

Mr. C. E. Schaff, Assistant General Manager of the Cleveland, Cincinnati, Chicago & St. Louis Railroad, has been appointed General Manager of the same.

Mr. George B. Roberts, President of the Pennsylvania Railroad, was on December 12 chosen Permanent Chairman of the Board of Control of the Joint Traffic Association.

Mr. A. D. Allibone has been appointed Purchasing Agent of the Wisconsin Central, with headquarters at Milwaukee, Wis., to take effect January 1, in place of Mr. J. A. Whaling, resigned.

Mr. J. R. Lane has been appointed Superintendent of the Macon & Birmingham, in charge of transportation, roadway and machinery department, with headquarters at Macon. Ga.

Mr. I. W. Fowle, who has been Master Mechanic of the first district of the Cincinnati, New Orleans & Texas Pacific, at Somerset, Ky., for about three years, has resigned to engage in other business.

The death of Mrs. Emiline Westinghouse has been announced. She was the mother of George Westinghouse, Jr., and H. H. Westinghouse. Mrs. Westinghouse was 86 years old.

Mr. W. C. Peterson has been appointed Foreman of the motive power and car departments of the International & Great Northern Railway, with headquarters at San Antonio, Tex.

Mr. E. P. Bryan has been appointed General Manager of the Terminal Railroad Association of St. Louis, succeeding Mr. Joseph Ramsey, Jr., who has become General Manager of the Wabash Railroad.

Mr. Philip Campbell, General Manager of the Birmingham, Sheffield & Tennessee River road in Northern Alabama, has resigned. His successor is Mr. Samuel Hunt, General Manager of the Cincinnati, Portsmouth and Virginia.

Mr. T. W. Adams, formerly foreman of car repairs of the Boston shops of the Boston & Albany Railroad, and a son of Mr. F. D. Adams, of that road, has been appointed Master Car Builder of the New England Railroad, with headquarters at Norwood, Mass.

Mr. E. H. Talbot has been appointed the Eastern representative of the *Railway Age* and *Northwestern Railroader*. He will be assisted by Mr. W. C. Ford, who for three years has represented the paper in the East. Mr. Talbot was the founder of the *Railway Age*, and was its President for 15 years.

Mr. Patrick Sterling, Locomotive Superintendent of the Great Northern Railway of England, died at Doncaster, England, November 11, aged 75 years. The vacancy has been filled by the appointment of Mr. H. A. Ivatt, formerly Locomotive Engineer of the Great Southern & Western Railway of England.

Mr Richard Durborow has been promoted to be Master Mechanic of the West Philadelphia shops of the Pennsylvania, vice M. Garrett, retired, and R. H. Garland has been promoted from General Car Inspector, with headquarters at Altoona, to be Assistant General Foreman of the West Philadelphia shops, succeeding Mr. Durborow.

Mr. P. H. Schreiber, who has been Master Mechanic of the second district of the Cincinnati, New Orleans & Texas Pacific for the past six years at Chattanooga, Tenn., has had his jurisdiction extended over the entire Chattanooga division, with charge of the Somerset shops in connection with those in Chattanooga. His headquarters will be at Chattanooga, as heretofore.

Mr. William Apps, formerly Master Car Builder of t Illinois Central, has been appointed General Master Car Builder of the Canadian Pacific at Montreal. He succeeds Mr. John Higginson, who recently resigned. Mr. Apps was formerly in charge of the car department of the Great Northern. He was afterward Master Car Builder of the Western of Alabama, and has also been with the Chicago & Eastern Illinois, and the Illinois Central.

On Jan. 1st Mr. Chas. M. Hays assumes the duties of General Manager of the Grand Trunk Railway, to which position he was appointed some months ago, succeeding Mr. L. J. Seargeant, who retires from the management of the road to act in an advisory capacity to the Board of Directors in London. Mr. Hays is an able manager, and his friends expect that he will make a record on the Grand Trunk which will be creditable to himself and exceedingly satisfactory to the owners and patrons of the road.

Mr. William F. Merrill, General Manager of the Chicago, Burlington & Quincy Railroad, has resigned to become Second Vice-President of the Erie Railway in charge of the operating department. Mr. Merrill has been General Manager of the C., B. & Q. since 1890, succeeding Mr. E. P. Ripley. He was born in 1842, at Montague, Mass., and began railroad service in 1866, and was employed as a civil engineer on several Western roads until 1880, when he became a Division Superintendent on the Wabash. Two years later he went to the Chicago & Alton as General Superintendent, and a year later he became Superintendent of the Iowa lines of the C., B. & Q., and four years later General Manager of the Hannibal & St. Joseph and the Kansas City, St. Joseph & Council Bluffs railroads, which form a part of the Burlington system. He occupied this position until he was promoted in 1890 to be General Manager of the C., B. & Q. proper. It is announced that he is to be succeeded by Mr. W. C. Brown, who has been General Manager of the H. & St. J. and the K. C., St. J. & C. B roads since 1890.

The Greatest Auction Sale.

The world's greatest auction sale occurred at Topeka, Kan., on December 10, when the vast property of the Atchison, Topeka & Santa Fe Railroad Company was sold to Messrs. Edward King, Charles C. Beaman and Victor Morawetz, representatives of the Reorganization Committee. The reading of the notice of sale occupied 30 minutes. This done, Judge Johnson said that, in pursuance of the notice of sale just read, he offered the property to the highest bidder.

"What am I offered?" the auctioneer asked.

"I offer $60,000,000," said Edward King, in a low voice.

"Do I hear any more bids?" cried Judge Johnson. "Once twice, the last call. The property is sold to Edward King, Charles C. Beaman and Victor Morawetz."

This ended the greatest auction sale ever known, and the crowd dispersed to the Federal Building, where Judge Caldwell held a session of court to confirm the sale.

As indicating the immensity of the sale it may be stated that the system proper embraces 4,670 miles of railroad, on which are now being used 864 locomotives, 28,187 freight cars, and 584 passenger cars. The system has practically been built within the past twenty years, the extension into Chicago being only about seven years old. Originally the line was intended to parallel the old Santa Fe trail, over which was transported the greater part of the commerce of the plains. Over 100 days were required to reach Santa Fe by freighters over this historic trail, the same route now being covered in twenty-eight hours by the road's overland trains. This commerce of the plains grew to such proportions that in 1858 there were on the trail 2,500 men in some way engaged in this traffic. In that year there were registered at Council Grove, Kan., 1,827 wagons, 429 horses, 5,316 mules, 15,714 oxen, and 67 carriages or passenger vehicles. During that year there were 9,608 tons of freight carried over the route, equal to about 500 carloads. There was over $2,500,000 directly invested in this business, with another $1,000,000 as an incidental investment. The trail started from Fort Leavenworth and from Independence Landing, formed a junction just below Lawrence, struck the Arkansas near where Great Bend is now situated, following the river 100 miles crossed and passed through the sandy country for about 60 miles to the Cimarron, which stream it followed to near the southwest corner of Kansas, thence in a general southwesterly direction to Sante Fe, 780 miles from Independence Landing. The present line of the Santa Fe follows practically the same route of the trail. Great opposition was made by the freighters to the building of the line.

The history of the management of the company since it was first organized has been a most varied one, and so many bright railroad officials have stepped to its head with great reputations as managers and had to retire beaten and oftentimes with discredit to themselves that the road has come to be known in railroad circles as a "man killer." In President E. P. Ripley, however, and Vice-Presidents D. B. Robinson and Paul Morton, an exceedingly able group of practical and progressive railroad men is now placed in control of this largest railroad in the world, and it is the confident expectation of those who know their ability and the resources of the road that the troubles of this great company are near an end.

Burglar Proof Express Cars.

A good deal has been said of late regarding the construction of so-called burglar-proof express cars for service on some of the railroads. The reports were to the effect that these new cars were to be made of steel with no windows or doors, or end platforms, and that they would be "collision proof." The President of the Adams Express Company, Col. L. C. Weir, in talking of the matter recently, said:

"It is all nonsense. We have cars equipped with burglar-proof and fireproof safes. These are strapped to the floor of the car, and they are as smooth as a baby's cheek. There isn't a crack where train robbers could possibly insert powder. When a train is attacked, and the robbers place a revolver under the nose of the messenger, he simply tells them: "All right, boys, help yourselves. There is the safe; I can't open it." And that stumps them. Whenever a robbery is reported, we are deluged with letters from all sorts of cranks and inventors over the country, each one of whom has a patent that is the only preventive. Only a short time time ago we had one letter from a chap who wished us to keep what he had to offer an inviolable secret. He said that he had not patented it, and was only waiting to hear from us. His plan called for the construction under the roof of the car of a chamber with falling doors. As soon as the robbers entered the car, all the messenger had to do was to throw a switch. This let down the doors of the concealed chamber. As soon as the doors fell, a blast of air was created from some mysterious source, and countless numbers of little balls of India ink would be thrown into the car, branding every man jack of the robbers indelibly for future identification, to say nothing of scaring them to death.

"Another chap I remember had a scheme that was unique. It consisted of the placing of a cylinder in the car. The moment the messenger appreciated that he was attacked all he had to do was to drag the safes into the cylinder and lock them up there alone with himself. The cylinder was punctured with holes, which commanded every part of the car, and through them he could shoot the robbers down one by one. When we asked him what was the matter with the robbers shooting back through these same holes and puncturing the messenger, he was stumped and retired. On some of the Western roads they are now trying a new plan. Each express car is equipped with one or more cylinders of small diameter, which are filled with a powerful chemical preparation. The instant the messenger inside has reason to think that his car is threatened he takes the cylinder down from its case and drops it through a prepared opening in the floor of his car. Then, by a pressure of the foot or some other simple method, he ignites the thing. The chemicals flame out and illuminate the country for a great distance around. The cylinder becomes a great torch. The experiment is being tried there, but whether it will be a success or not remains to be seen.

So far as this company is concerned, there is not at the present time a single man out of durance vile who ever robbed the company; that is, enless his term has expired. This is true from the days of the Reno gang, and that was more than 30 years ago. It costs money to round them up, but we never let up in the search."

The Car Builders' Demand.

One of the most marked features of the lumber trade this year has been the steady, large and imperative demand from railroad companies and car shops for car building material. The panic of 1893 and the resulting depression in general business largely stopped the requirement for car and other railroad material. About the only buyers were roads in the hands of receivers, which were able to devote part of the earnings to the maintenance of way which supposed-to-be solvent roads devoted to the paying of interest. The result was that a year ago and in a more marked degree in 1894 side tracks and freight yards were encumbered with disabled equipment which was not immediately needed, and for the repair of which there were no available or appropriated funds.

In the midst of such a condition of things came a revival in business, a revival which, without much of the boom element in it, nevertheless was substantial and large. Repair work was taken up with vigor, and as the year progressed it was evident that new equipment was needed. Consequently the car shops have been crowded with work both on repairs and new construction, with a marked influence on the lumber trade.

The remark has been made that the salvation of the lumberman of Georgia has been the demand for car ma terial. The fir manufacturers of Oregon and Washington have largely benefitted, and in every line of the lumber trade the freight car requirement has given business and profit. This has been so even in the white pine trade and is one of the most cheerful features of the winter season, for the car demand has not yet abated in any marked degree.

In the wholesale markets like Chicago, the quietude of later December and early January is enlivened by an overhauling of the yards in getting out car lining and other similar stock. A common board or strip may have at one end four or five feet which is just what the car builder wants; and when otherwise the yard crews have little to do, they are taking down piles and remanufacturing the lumber in them so as to get better results in the aggregate than could otherwise be the case. The 175,000 miles of railroad in the United States with their requirement for ties, bridges, fencing, stations and cars furnish a no inconsiderable proportion of the lumber requirement of the country.—*The Timberman.*

The Most Advantageous Dimensions for Locomotive Exhaust-pipes and Smoke-stacks.

BY INSPECTOR TROSKE.

[Previous to the consolidation of the NATIONAL CAR AND LOCOMOTIVE BUILDER with the AMERICAN ENGINEER AND RAILROAD JOURNAL three portions of a translation of Herr Troske's very valuable paper, were published in the last-named journal. If succeeding portions were continued seriatum in the new publication, the readers of the NATIONAL CAR AND LOCOMOTIVE BUILDER would have been without these first parts. It has, therefore, been thought best to republish them in the consolidated journal.]

It is well known that the efficiency of a locomotive depends more upon the steaming qualities of its boiler than it does upon the proper dimensions being given to its principal parts and the adhesive weight that may be upon its wheels, and that this steaming quality is, in turn, dependent upon the combustion taking place upon the grate, and that this is finally dependent upon the strength of the draft. If this latter is too weak, the fire burns sluggishly and the steam production is low; while, on the other hand, if it is too strong there will be many pieces of unburned coal drawn through the flues, which will accumulate in the smokebox as cinders, oftentimes even blocking up that space, or a portion will be thrown out of the stack as sparks; either case serving to increase the coal consumption unnecessarily. The draft may even be so violent, as a result of improper dimensions being given to the exhaust-pipe and the smoke stack, that in many locomotives it will be found that the fire no longer rests quietly upon the grates, but dances up and down upon them; which not only has the evil effect of increasing the consumption of coal by a very appreciable amount, but admits more cold air through the air spaces into the firebox than is actually needed for maintaining combustion. This excess of air lowers the temperature in the fire-box and the tubes, and as a consequence injures the production of steam. By contracting or enlarging the mouth of the exhaust-pipe, we know that we can easily increase or weaken the draft, but there are well-defined limits in both of these directions. Contraction goes hand in hand with an injurious back pressure upon the piston, resulting in just so much work lost by the locomotive; while an increase in the diameter of the pipe causes a lessening of the vacuum in the smokebox and firebox, so that finally the equalizing reserve action of the exhaust disappears, and the four exhausts for each revolution of the driving wheels are always sharply defined from each other, the steam, instead, as is the case when running at high speeds, of approaching continuity, now issues from the stack under separate impulses, and thus no longer acts uniformly upon the fire, but in a jerky manner. These are, therefore, the outlying limits to good and economical consumption of coal.

Furthermore, we are dependent, not only upon the proper size of the exhaust nozzle, but also upon its position below the bottom of the stack opening, and upon the dimensions of the stack itself—that is, upon its diameter, height, and position. These four dimensions have no less influence upon the action of the fire and the generation of steam than the exhaust nozzle itself. As with the exhaust nozzle, so by enlarging or diminishing the size of the stack, the draft may be lessened or increased, also by shortening or lengthening the same and finally by raising or lowering the exhaust nozzle with reference to the stack.

HISTORICAL SKETCH.

Soon after the construction of the first railway, experiments were instituted for the purpose of locating the exhaus nozzle in the most efficient position, and it is well known that Stephenson owes his victory in the locomotive contest at Rainhill, in 1829, to the fact that he was the first to make an application of the exhaust nozzles to boilers for inducing a greater draft. Pambour, in 1836, was the first to institute a systematic series of experiments. He made, however, only a few, and the results that he obtained are of no great value. Nevertheless Pambour set forth the proposition that the exhaust-pipe pressure varies directly as the speed of the piston and the generation of steam per hour, and, therefore, inversely to the sectional area of the pipe itself. He considered that the pressure in the exhaust-pipe was the same as the back pressure upon the pistons, until, in 1847, it was proven by Gouin and Le Chatelier that this is not the case. Among the French engineers who busied themselves with this question at that time was Polonceau. He made some special experiments with exhaust nozzles of various sizes.

Clark first threw light on these subtle relationships by means of his very important and thorough investigations which were made in 1850. They were made upon a large number of locomotives, and from them the following results were obtained:

1. The vacuum in the smoke-box stands in direct relationship to the pressure in the exhaust-pipe. That is, the vacuum expressed in inches of a water column gives the pressure in the exhaust-pipe in inches of mercury:

$$\frac{\text{Vacuum in smoke-box}}{\text{pressure in exhaust-pipe}} = \frac{1}{13.6}$$

or, in round numbers, $\frac{1}{14}$.

2. The draft creating properties of the exhaust is, first of all, dependent upon the form and size of the stack and the position of the nozzle. Above does the height of the exhaust opening and the diameter of the stack influence this matter.

3. With each stack there is some maximum size of exhaust nozzle that will produce the best results. For a given boiler there is only one diameter of stack that is most efficient; and for all other diameters the nozzle must be contracted.

4. The best position for the exhaust nozzle is that from which the steam will be blown vertically into the stack. Hence the center line of the nozzle must coincide exactly with that of the stack.

5. The products of combustion must be able to enter the stack easily, either by making the bottom bell-shaped, or, better still, by locating the exhaust opening below the top of the smokebox by about the diameter of the stack.

The exhaust will thus be always blown through and through the products of combustion, and not merely over the top of the same. A straight, vertical exhaust pipe is therefore greatly to be preferred to the crooked pipe that was formerly in general use, since it offers less resistance to the steam as well as to the gases in their passage to the stack.

6. The proper sectional area of the exhaust nozzle is dependent upon the grate area, the sectional area of the tubes, the diameter of the stack, and the size of the smokebox:

The larger grate area and the sectional area of the tubes in the firebox tube-sheet, and the smaller the diameter of the stack and the size of the smokebox, the larger it is possible to make the nozzle.

7. In order that a stack may work at its maximum efficiency, it must have a length that is approximately about four times its diameter.

8. The smallest sectional area of stack that was observed was one-fifteenth of the grate area, and this permitted the use of a larger exhaust nozzle than any other larger stack. So that these observations are taken to indicate that this proportion (one-fifteenth) is the most efficient.

9. The exhaust nozzle may have a sectional area equal to from one-sixty-sixth to one-ninetieth of the grate area, provided that the sectional area of the tubes in the firebox tube-sheet shall be made from one-fifth to one-tenth of the grate area.

10. The vacuum in the firebox is from one-third to one-half of that in the smokebox.

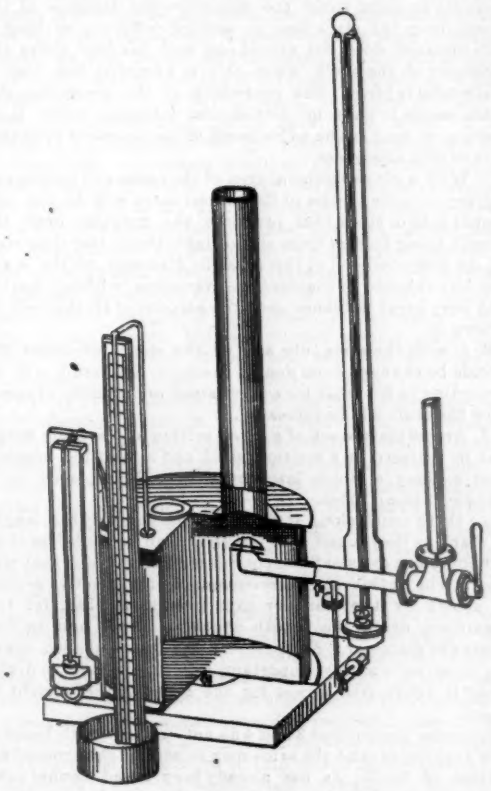


FIG. 1

[THE ZEUNER APPARATUS.

It should be remarked just here that the English locomotives of those days had very small grates, whose area did not average more than 12 square feet; hence, Rules 9 and 10 cannot be applied to locomotives of the present day. Also, Rule 3 and the second paragraph of Rule 6, in which it is stated that the exhaust nozzle can be enlarged as the diameter of the stack is made smaller, cannot be applied in its general construction to locomotives. According to the Hanover experiments, the vacuum can be increased by making the diameter of the stack less. With this, if the original vacuum is to be retained, the nozzle may be enlarged, which will result in the lowering of the pressure in the exhaust-pipe, and the back pressure upon the piston; but, as I stated at the opening of this paper, this enlargement of the nozzle must take place between narrow limits, else the combustion will be poor and the coal consumption increased. For this reason, then, it would be inexpedient to use that small size of stack that would permit the largest nozzle to be used.

Furthermore, my investigations have led me to the belief that it is generally desirable to use as large a stack as possible. Especially worthy of note in the Clark rules that are given above are the results 2 and 5, wherein it is asserted that the height of the nozzle has an important influence upon the action of the fire, a position that is disputed as being incorrect by some later writers. Later, during Peacock's experiments, Clark was Locomotive Superintendent of the Manchester, Sheffield & Lincolnshire Railway, and in the summer of 1850 undertook a series of experiments with locomotives, and found that by lowering the opening of the exhaust-pipe and enlarging the same he could secure a better production of steam.

In the locomotive under consideration, which had a cylindrical stack with a diameter of 18 inches and having originally a nozzle 4¼ inches in diameter that was 1 inch above the top of the smokebox, it was gradually dropped until it was 18 inches below the top of the smokebox, where a nozzle with an opening of 4¾ inches gave the best results. As a result of this experiment Peacock placed all of his nozzles at this distance below the top of the smokebox.

In Germany, Switzerland, and other countries these results seem to have been followed without any change up to the present time.

Zeuner.—Eight years after these experimen ts, in the summer of 1858, Zeuner began his well-known experiments upon the exhaust-pipe, which he continued during the following year, and in 1863 published his epoch-making book, "The Locomotive Exhaust-Pipe," and embraced therein his theory of its action.

Zeuner carried on his experiments in the workshops of the Zurich Railway with an especial apparatus. In order to render a comparison possible between the results obtained by various experimenters, who have made use of special apparatus, and determine the value of their deductions, it will be well to give a short description of them.

The Zeuner apparatus is shown in Fig. 1. It consists essentially of a sheet iron chamber having a diameter of 22.44 inches and a height of 17.7 inches, into which the steam-pipe from the boiler projected carrying the blast nozzle at its extremity. Upon the top of this chamber the stack was placed and through it the steam with the air that had been drawn in escaped. Afterward an opening about 4 inches in diameter was made in the top for the purpose of admitting air. The steam pressure in the blast-pipe was regulated by means of a hand-cock and measured by a quicksilver gage, while the vacuum that was induced in the chamber was also measured by a similar gage and a water column.

The stacks, of which there were five, had clear diameters of 1.6 inches, 3.2 inches, 3.9 inches, 4.7 inches and 5.8 inches, while the blast-pipe had diameters of .39 inches and .56 inches.

In the air opening for the purpose of changing its sectional area there were placed rings having clear openings of .39 inch, 7.8 inch, 1.56 inches, 2.26 inches and 3.15 inches inside diameter.

From these investigations, which embraced over 2,000 measured observations with this apparatus, and from his theoretical opinions, which were the first upon this subject that were examined in so thorough a manner, Zeuner came to the following conclusions:

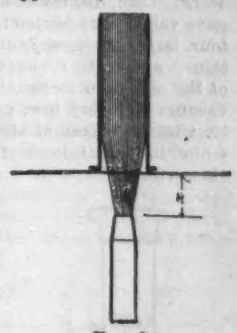


FIG. 2.

1. The distance x, as given in Fig. 2, which is the distance of the top of the nozzle from the bottom of the stack, can be varied between tolerably wide limits, without particularly disturbing the evenness of the ratio of the vacuum existing in the chamber during the outflow of steam.

Nevertheless, he adopted as the result of his investigations 1.57 inches as being the distance equal to x, at which the stream of steam could enter the different stacks with the least hindrance.

2. In general, the opening of the blast-pipe must be raised and brought nearer to the mouth of the stack, as the latter is made smaller, provided the vacuum is to be kept the same. It may be possible to take the distance of the opening of the blast-pipe below the opening into the stack as equal to from one to two times the diameter of the stack that is being used.

3. In general it happens, in consequence of the friction of the steam and air in the stack, that there is a marked diminution of the suction action of the stream of steam, if the length of the pipe is more than 30 times the diameter.

4. It was also observed that the position of the blast-pipe relatively to the opening into the stack, the capacity, and, in a general way, the very shape of the smoke-box of a locomotive, and, finally, the height of the stack, have all a very important influence upon the action of the exhaust. At least it may be asserted that locomotives built to-day in accordance with these directions can hardly be improved.

5. The vacuum—that is, the difference existing between the pressure in the chamber and that of the atmosphere—increases in a direct ratio with the steam pressure. It does not depend upon the absolute size of the steam opening, the air opening and the stack, but upon the ratio existing between the first and the last, and the quotient:

$$\frac{\text{Area of steam opening}}{\text{Sectional area of stack.}}$$

6. For a given size of blast pipe and air opening, there is always some diameter of stack, wherein the sucking action of the steam current is the greatest, and with all other diameters this action is weaker. This point of maximum efficiency leaves one in a position to define the theory of the action very sharply.

7. With the same nozzle opening and stack, the amount of air drawn in varies directly with the square foot of the steam pressure.

8. The ratio existing between the vacuum in the smokebox and the pressure in the exhaust-pipe is variable, and, with the ordinary blast-pipe arrangements, depends essentially upon the cross-section of the blast-pipe opening and a known co-efficient, u, indicating the resistance of the products of combustion in the tubes. If, therefore, we adopt the common acceptation of the results of Clark's experiments, which have been used up to the present time, this ratio becomes one-fourteenth for locomotives, and that only an approximation and applicable, also, only to the locomotives upon which Clark conducted his investigations. On the whole, however, it appears that, when everything has been taken into consideration, this ratio can be subjected to no very great fall, provided the heating and running of the locomotive is normal.

* Translation of a paper read before the German Society of Mechanical Engineers.

It must be remarked just here, however, that the conclusions announced in Nos. 1, 3, 4 and 6 are not in accord with the results of the experiments carried out in the Leinhausen shops in the years from 1892 to 1894. In opposition to Zeuner, it must be said that the position of the exhaust nozzle relatively to the bottom of the stack, as well as the length of the stack, certainly does have an influence upon the working of the draft. Further, this is evidently not limited to a stack having a length equal to 30 times the diameter, but to one with a length of six diameters. Finally, that diameter of stack which showed the highest vacuum in the apparatus cannot be said to be universally the most efficient, since upon a locomotive it might act very unfavorably. We can see from the data developed by the Hanover experiments that the vacuum rises, the other conditions remaining the same as the stack is made smaller; that is, within certain defined limits and beyond these limits it falls rapidly away. This stack, which in the apparatus gave the best draft, is too small for a locomotive, the ratio between whose grate and tube areas is based upon the dimensions of the experimental apparatus, and, consequently, would not give a proper draft to the fire nor an economical coal consumption, and so cannot be claimed to be the most economical. This brings up still another influence that will be referred to later.

That Zeuner reached the other results which he has promulgated depended upon his choice of the dimensions of his apparatus. Not only was the stack altogether too long, but it was far too large in comparison with the diameter of the blast nozzle that was used. The latter had, as we have already said, a diameter of only from .39 inch to .56 inch, while the former was 1.6 inches, 3.2 inches, 3.9 inches, 4.7 inches, and 5.8 inches. Hence, the diameters of these stacks were 4, 8, 10, 12, and 15 times as large as the .39 inch blast nozzle.

Now, in actual locomotive practice, as well as in the recommendations of Zeuner, we have nozzles varying in diameter from 3.5 inches to 5 inches. Suppose we take one with a diameter of 4 inches, we must, in accordance with the data given by this apparatus, have five stacks with diameters of 16 inches, 32 inches, 40 inches, 48 inches, and 60 inches, sizes which naturally are wholly out of the question for practical work. Then, too, the smallest stack of the Zeuner apparatus gave values that varied from those obtained from the other four large ones, yet Zeuner disregarded it in his investigations, although it approached more nearly than any of the others to locomotive practice; and, in addition, the vacuum was very low, giving a water column of only 1⅝ in. with an excess of blast-pipe pressure of ¼ atmosphere, while in actual locomotive service it is at least double this, with a blast-pipe pressure that is considerably lower.

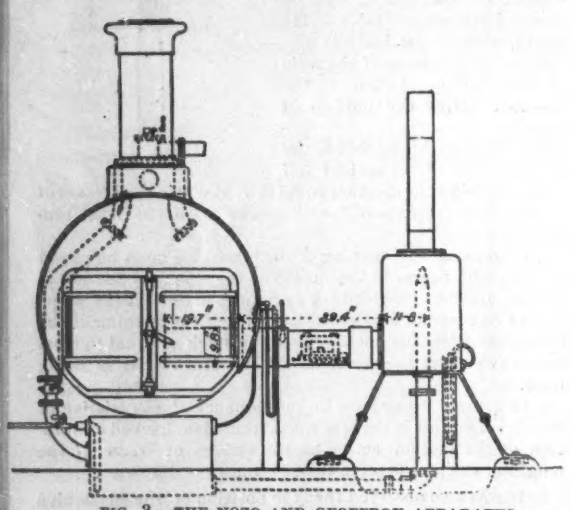


FIG. 3.—THE NOZO AND GEOFFROY APPARATUS.

It is also highly probable that in the further stack experiments air was drawn in from above, as was shown to be the case in the Hanover experiments. From this point of view, also, Zeuner found a very slight difference in the vacuum, whether he conducted his experiments in an open or perfectly tight chamber, and from the same standpoint he found no marked influence due to the length of the stack, although he gradually shortened it from an original length of 4 feet 11 inches to 14¾ inches. What an important influence this variation in length does have upon the action of the exhaust is evidenced by the Hanover experiments. Although it should happen that not one of the values derived from these experiments should have a practical working value, we still have the service which the genius of Zeuner rendered in developing the theory of the blast-pipe, and for which the painstaking investigations which he carried out were necessary.

Nozo and Geoffroy.—At almost the same time with Zeuner—that is, in the Fall of 1860—the French engineers, Nozo and Geoffroy, carried out some similar experiments, independently of Zeuner, but also with cylindrical stacks only, since up to that time no other shape was known. The apparatus used by them is illustrated in Fig. 3. It was similar to the Zeuner apparatus, yet with this essential difference, that it was not cold air but the products of combustion of a locomotive which were drawn in, and that the boiler of the same supplied the steam for the experiments. The steam was led from the throttle into a special reservoir of 11.3 cubic feet capacity, and in this, while each test was being carried out, a constant pressure was maintained, which could be accomplished by means of the throttle-valve and one on the reservoir opening into a wastepipe. The blast-pipe chamber also had a capacity of 11.3 cubic feet. In the pipe used for conducting the products of combusion into the chamber, an anemometer was placed which could be read through a glass-covered peephole. In order that the experiments might be carried on with openings for the admission of air of different sizes, false plates with holes of the same size, but varying in the number of the same, were placed in the blast chamber in front of the air-pipe. During these experiments the locomotive boiler was fitted with a stack 21 feet 3⅛ inch high, whose natural draft sufficed for the generation of the steam.

The experiments were made with four blast-pipes of .39 inch, .55 inch, .79 inch, and 1.1 inches diameter, and 10 stacks varying in diameter from 1⅝ inches to .79 inch in diameter. The height of the latter was equal to eight times its diameter. The perforated plates had a free sectional area through holes of .35 inch diameter that varied in number from 20 to 320. The steam pressure in the receiver varied from 1 to 11½ pounds per square inch.

Upon using a blast nozzle having a diameter of 1.6 inches, a stack 5.5 inches in diameter, and a steam pressure of 2 pounds per square inch, a vacuum equivalent to a water column of 1.7 inches would be obtained in the smokebox of the apparatus, while the temperature of the air that had been drawn in would be about 313 degrees Fahr. If the steam pressure was increased threefold to 6 pounds per square inch, a vacuum of 5.555 inches would result, and the temture would rise to 331 degrees Fahr., which was about one-half the true temperature. Nozo and Geoffroy arrived at the following conclusions:

1. Each length of stack that gives the maximum results is independent of both the area of the blast nozzle and the passage for gases, but not of the steam pressure, and is but slightly independent of the diameter of the stack. It must be from six to eight times that diameter. A greater length has no influence.

2. A funnel-shaped opening to the bottom of the stack seems to have no marked influence upon the draft.

3. A stack of suitable length can project down into the smokebox to the top row of tubes without injury to the draft, if the blast nozzle is dropped at the same time; but the draft is very seriously impaired if the lower end of the stack is plunged down into the stream of gases.

4. With a proper length of stack—that is, one varying from six to eight times the diameter—the distance of the nozzle from the stack has no marked influence so long as this distance does not exceed one and one-half times the diameter of the stack; when this is exceeded the draft is materially injured. The projecting of the nozzle into the stack seems to have no detrimental influence worth mentioning, so long as the adjustment of the nozzle is such that it is in true alignment.

5. With a given sectional area of the tubes and nozzle, and a given velocity of flow of the steam, there will be one sectional area of stack that produces the greatest draft, the length being held at from six to eight times the diameter, In the neighborhood of this area the diameter of the stack can be subjected to considerable variation, without having any very great influence upon the amount of air that will be drawn in.

6. If with the same tube area or the same resistance the nozzle be changed from double to single, the result will be according to five, that for a given stack and velocity of steam flow the draft will be increased.

7. An ordinary stack of a given section and a single nozzle can be replaced by a multiple stack and a multiple nozzle—that is to say, a single large nozzle can be replaced by a bundle of small tubes.

To these conclusions it may be remarked that the length of stack as they found it is too great, and is doubtless to be attributed to the small dimensions of the apparatus that was used. The ratio which corresponds to the effective action, as shown by the Hanover experiments, is that, for the maximum draft, the length should be from four to five times the diameter. Furthermore, the funnel-shaped opening does have a very important influence upon the draft, since it offers free access for the gases to the current of steam.

Likewise conclusions 3 and 4 do not coincide with locomotive experience, and the same may be said of the concluding portion of No. 5. As has already been noted, Zeuner says that a stack always maintains the best draft at a given ratio. Conclusion 6 is likewise at fault, for, for each diameter of nozzle there is also only one cylindrical stack that will give the maximum draft, provided the length remains unchanged, whose diameter increases the larger the nozzle that is used with the same steam pressure.

Conclusion 7 is of no practical value for locomotive work.

Nozo and Geoffroy also conducted their experiments upon a running locomotive while it was hauling a train. In this work they used seven different stacks having diameters of 9 inches, 11 inches, 12.5 inches, 14 inches, 15.4 inches, 17.7 inches and 17.8 inches, whose lengths were 6 feet 2.8 inches. The nozzle had a diameter of 4.3 inches, with its opening 3.9 inches below the bottom of the stack, so that the effective height of the stack was 6 feet 6.7 inches.

The results obtained from these experiments were as follows:

The three stacks, with diameters of 9 inches, 11 inches and 17.8 inches, were useless, while with the other four the trip could be readily made on schedule time. The stacks with diameters of 12.5 inches, 14 inches and 15.4 inches diameter, gave a plentiful supply of steam. A graphical result was drawn for each stack, and these showed that the diameter of 14 inches was the best for the locomotive under consideration.

Regarding these experiments, it may be said that the action of the stack appears to be judged entirely by the amount of draft obtained; but this construction is not the only one that should have an influence, for, in Germany at least, it is required of the stack that the fire shall not only work properly and burn quietly, but that the amount of coal that is carried from the firebox to the smokebox shall be as small as possible, thus cutting down the amount of sparks and cinders. It seems odd, too, to note in this report that with a stack of 17.7 inches diameter the trip was made on schedule time, while with a stack of 17.8 inches in diameter, or only .1 inch larger, the action was unsatisfactory. Here, at all events, there must have been some other circumstances at work which could not have been known to the observers, so that the experiments of Nozo and Geoffroy are of little value for the construction and operation of locomotives of the present day.

Prusmann: A later experimenter in this matter, Prusmann, the inventor of the conical smokestack that has been named after him, must be mentioned. He began his experiments about the end of the year 1860, which was at about the same time as those conducted by Nozo and Geoffroy, but he went into the work so extensively, that they were not completed until the beginning of 1863. His paper was published in the *Organ fur die Fortschritte des Eisenbahnwesens* in 1865, and in the same year it also appeared in book form, where he gathered together his extensive results that had been reached with so much labor.

In Figs. 4, 5 and 8 the experimental apparatus that was used by Prusmann is shown. Fig. 4 shows the first arrngement that was used. It consists of a cylindrical box only 3.28 inches in diameter, through whose cover the cylindrical stacks having the same outside but varying inside diameters could be slipped and then held in any desired position by a set screw. The blast-pipe entered through the bottom, and was connected with the boiler by means of a pipe in which a cut-off cock was placed. The opening of this cock could be

Fig. 4.

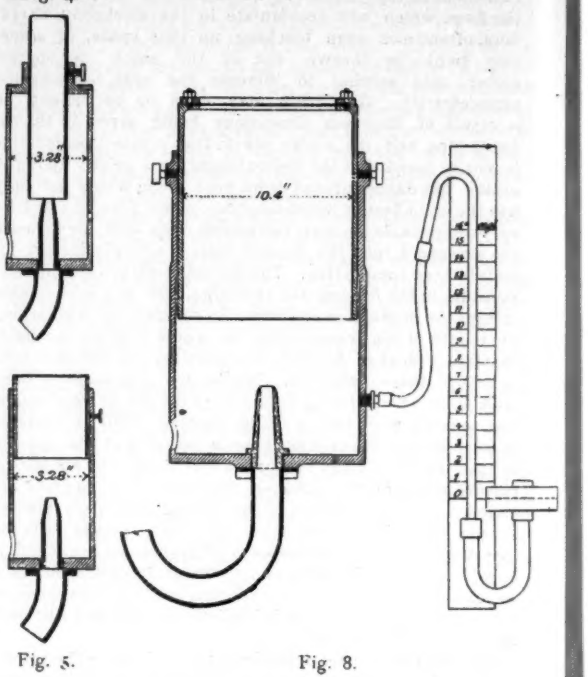


Fig. 5. Fig. 8.

made anything that was desired by means of a handle fastened to its square stem and moving over a graduated arc, thus permitting of an exact regulation of the blast-pipe pressure. Directly over the bottom of the box, as shown at the left in Fig. 4, there was an opening 1⅛ inches in diameter, through which the air was drawn in by the suction created in the interior. The vacuum was measured by a water column in the form of a siphon shaped glass tube, whose connection with the box was packed with a rubber washer, the exact blast-pipe pressure not being obtained, but merely that existing in the boiler, while the experiments were in progress, which was read on a metallic pressure gage. In his experiments Prusmann chose only such openings of the cock on the apparatus as would produce a vacuum equal to that prevailing at that time in the current practice on the locomotives of the Hanoverian State Railway—namely, from 6 to 7 inches, which was obtained by placing a stack on the experimental apparatus corresponding to that in use upon these locomotives. The nozzle of the blast-pipe had a clear diameter of 0.32 inch, and the seven cylindrical experimental stacks had diameters of about 1.25 inches, 1.33 inches, 1.5 inches, 1.58 inches, 2.125 inches, 1.7 inches and 1.77 inches.

Prusmann formulated the following conclusions as the result of his experiments:

1. The blast-pipe pressure within the limit of current practice has no influence in determining the proper shape of the stack.

2. The increase of the distance from the bottom of the stack to the top of the blast nozzle is not exactly an equivalent, but as it is increased, of course within certain limits, it is accompanied by a corresponding increase in the height of the vacuum.

3. Of the seven experimental stacks used, the one of the mean diameter of 1.58 inches showed the best results.

4. With a stack of the most efficient diameter, its height should be so adjusted that it stands at least four times the diameter of the blast-pipe above it, in order that this latter may be at a proper distance from the lower end of the stack.

5. For every height above the blast nozzle there is one cross-section of stack that will give the most efficient working.

In order to investigate these latter results which he had obtained, Prusmann changed his experimental apparatus so that he replaced the solid cover by a movable open shell, like that shown in Fig. 5, that could be fastened in position, and on the upper end of which plates having circular openings of different sizes could be bolted. The diameter of the openings in these plates varied by one-eighth inch from 1 inch to 2¼ inches. By changing the shell the 11 plates were set at a greater and greater distance from the blast-pipe, varying from 0 to 7.6 inches, and in this way the vacuum was measured for 39 different positions. Prusmann thus obtained 11 series of results with 39 figures in each, which he put together in the form of a table, and in such a way that for each of the 39 positions of the blast-pipe the 11 different vacuums that were obtained formed a horizontal series. In each of the vertical, as well as the horizontal, series there was one of the highest efficiency.

He drew therefrom the following conclusions:

6. For each diameter of opening in the plates there is one distance from the blast-pipe that gives the highest vacuum.

7. The proper form of stack is not a cylinder, but a pipe whose diameter varies with the distance from the blast-pipe.

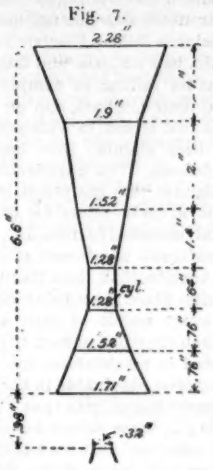
Now when Prusmann had laid out the blast-pipe distances already mentioned upon a vertical axis, and had then drawn parallel lines through these points, he then laid out upon each side of the vertical, the radius of that plate opening which, for the corresponding distance from the blast-pipe, gave the highest vacuum, and thus obtained a series of circular sections, as indicated in Fig. 6, that outlined the general average form of a cone, and from which the conical form of stack was deduced.

Prusmann made a stack of this shape out of tin, placed it upon the apparatus, and ascertained, by very careful adjustments, that distance of the lower end of the same from the blast-pipe where the highest vacuum was obtained. He then experimented with several tin stacks of similar shape and finally developed that shown in Fig. 7 as being the form that showed the highest efficiency.

It is worthy of note that a cylindrical section was located in the narrowest portion for the sake of avoiding the sharp angle that would otherwise exist between the top and bottom parts, and thus avoid a too rapid widening above and below.

Fig. 6.

Fig. 7.



Prusmann then made a stack for a locomotive of exactly this shape, with dimensions proportioned in the ratio of the blast-pipe dimensions of the locomotive to those of the experimental apparatus, which was $\frac{2.79 \text{ in.}}{0.32 \text{ in.}} = 8.594$. The most contracted portion of this stack had a diameter of 11 inches and stood at a height of 27 inches above the top of the nozzle. The locomotive upon which it was placed, and which had formerly made sufficient steam to do its work with a cylindrical stack having a diameter of 15 inches, was now found to act in such a way that the exhaust nozzle could be opened .28 inch, and an average saving of 23.81 per cent. in the consumption of coal effected, which in some cases arose to as much as 42.2 per cent. On a second locomotive, which had a blast nozzle of about 42.2 per cent. greater diameter, or of 3⅜ inches diameter, and a conical stack of correspondingly larger dimensions, or $\frac{3.375}{0.32} = 10.547$ times larger than those given in Fig. 7, the experiment was a complete failure. "The production of steam was often insufficient, and the coal consumption for the same loads was even increased." From this Prusmann concluded that his method of treatment was a wrong one, in increasing the dimensions of his experimental apparatus in a direct ratio, for it appeared that in the case of the 42.2 per cent. increase in the size of the blast-pipe he had taken it for granted that the grate area had been increased in the same proportion. In order to obtain information upon this point Prusmann built a third and larger apparatus. Fig. 8 illustrates this on a scale of one-tenth its actual size. The larger scale, which was attached to the water-gage, enables more accurate readings to be taken than were possible with the siphon gage. This third apparatus varies from the two others and also from the apparatus of Zeuner and Nozo in that it had three openings arranged concentrically with the blast-pipe, through which the air that was drawn in entered, and which favored the production of the vacuum. The size of these three openings was ascertained from a locomotive whose wheels and pistons were blocked. The valve was raised and so arranged that with the throttle wide open only so much steam could escape through the blast-pipe by way of the contracted openings in the valve passages, that with the ash-pan damper open, as it usually was while running, a vacuum of 6.8 inches of water was obtained in the smokebox. Then the ashpan damper was quickly closed tight, the tube openings into the smokebox closed as tight as possible with sheet iron, and an air damper in the smokebox door opened until a vacuum of 6.8 inches was again obtained in the smokebox. This gave, for coa and coke burning, a free opening equal to the total grate area divided by 21. This ratio was incorporated in the appa ratus, and a series of experiments made which also included the use of a nozzle of ¾ inch and one of 1 inch in diameter, with which the height of the stack opening above the same varied from 4½ inches to 25 inches. The results obtained were again tested in part with the small experimental stacks, and led to the following conclusions:

8. Making the conicity of the blast-pipe more blunt has a tendency to lower the stack, but, on the other hand, the conicity of the blast-pipe is without any influence upon the distance of the smallest portion of the stack above the nozzle, or upon the diameter of that portion.

9. Under the same circumstances the taper of the shells of stacks remain nearly the same for all locomotives in similar service, provided only that the ratio of the cross-section of the blast-pipe to the grate area remains the same.

10. A stack made for a given blast-pipe must, if all the other ratios remain the same, be enlarged over all by about the difference in the blast-pipe diameters, if we wish to use a larger blast-pipe with this same taper.

11. On non-condensing locomotives, whereon it is desired to increase the diameter of the blast-pipe, if the blast-pipe pressure remains the same, the distance of the smallest portion of the stack from the top of the nozzle will be unchanged.

12. The upper portion of the smokestack lying above the smallest portion of the same does not consist of a single truncated cone, but of three truncated cones of different inclinations, these inclinations becoming greater toward the top.

Finally, Prusmann gave a number of formulæ for calculating the dimensions of stacks and blast-pipes. The one for the location of the blast nozzle taken as t for all locomotives is:

$$t = 2.3673 + 0.857{,}047{,}767\,\delta - 0.136{,}138{,}202\,\delta^2 + 0.525{,}258{,}551\,\delta^3,$$

wherein δ is the diameter of the blast nozzle in inches.

It may, however, be remarked that, though these experiments were carried out so thoroughly and with so much trouble (for in all Prusmann used 18 different stacks on his apparatus, two of which were similar to those used upon locomotives, and 26 different plate openings) they are not entirely free from objections. Next the dimensions of the experimental apparatus were altogether too small, while the method of measuring the steam pressure was defective. In the first place, the boiler pressure should not have been measured, since it is always liable to a continual shrinkage; secondly, the boiler used had to supply steam for the shop engine of the works, and then these measurements should not have been taken with a metallic gage, since it was evidently far from being sensitive enough for a current of steam flowing through an opening of 0.3 inch. A quicksilver gage should have been used in this place, by means of which an accurate measurement could have been made of the pressure existing between the blast nozzle and the controlling cock. By moving the long handle attached to the cock, it would have been easy to have held this pressure at one point. It is to the imperfection of these measurements that we must ascribe the fact that, from the various tables of figures given by Prusmann, no accurate diagram of exactly what took place can be reproduced: for if we make a graphic delineation of the values given for a series of experiments, we get in most cases not a regular curve, but a broken line, between whose several parts there are wide variations of direction, and this is especially the case if we refer to Tables I., III., V., XII. and XVII. of Prusmann's work. In the last-named table there are, in several instances, two different values for the vacuum produced by the same position of nozzle, which is evidently impossible if the steam pressure remains the same; but before all others in inaccuracy is the statement that that plate opening which, with a given position of the nozzle, gave the best vacuum is the most efficient. This is seen, as a glance at the table teaches, in that the shortest distance is an accompaniment of the smallest opening, while the greatest distance between nozzle and plate is the one belonging to the next to the smallest opening. From which the stack indicated therefrom would evidently be too small. With the stack thus obtained Prusmann experimented still further, and deduced therefrom each location of blast nozzle from the smallest section of stack under consideration, at which the highest vacuum could be produced. This distance he now took as that at which the highest efficiency could be obtained, and transferred it into terms of the ratio of the diameters of exhaust nozzles upon locomotives; but such a performance is not at all permissible, as the Hanover experiments clearly show, for these nozzle distances having the strongest action come out many times as great on many locomotives. If we were to make an application of the Prusmann formulæ given above to exhaust nozzles of 4 inches or 5 inches in diameter, the distance of these nozzles from the smallest section of the stack would, according to Prusmann, be 37.8 inches for the first and 70 inches for the second, values that are unheard of in practice. That the Prusmann stack is above all things too small has long been known. Grove speaks of this in his well-known "Theory of the Blast-Pipe" (1874), and frankly discusses the reason therefor in "The Impossibility of Establishing the Shape of the Stack by Means of the Passage of a Current of Steam through Openings in Thin Plates," but, as we have stated above, this is not the principal reason for objecting to the results given.

There are, however, some results which Prusmann obtained from his experiments, inaccurate as they were in part and inapplicable as they are to the practice of the present day, which are full of significance for all time, and among them are those that led to the construction and development of the conical stack, which by varying its height above the nozzle within certain limits produces the best vacuum.

Zeuner: A very interesting continuation of the experiments of Prusmann was commenced a year later by Zeuner, and published in 1871 under the title of "On the Action of the Blast Apparatus of Locomotives with Conical Flaring Stacks."

Unfortunately Zeuner had, as he says in writing of this work, no knowledge of the results which the Prusmann experiments had yielded, so that he turned to his earlier experiments with cylindrical stacks that were previously briefly outlined but in other respects the information elicited was that resulting from a purely mathematical calculation. In consequence thereof his theory included, not the conical stack, but the location of the blast nozzle and its influence upon the action of the draft; the length of the stack is also disregarded. He laid down the following principles:

1. For a given diameter of blast-pipe and sectional area through the tubes, there is one most efficient sectional area of stack, measured at the smallest point, with which the maximum draft can be obtained.

2. The vacuum in the smokebox and the inrush of the mixture of air and gases increases as the flare on the upper end of the stack is increased, but a moderate amount of this flare soon gives an action that is perfectly satisfactory.

The conical stack will admit, for the same draft action, of a large exhaust nozzle opening. For the same train speed, therefore, it gives more power to the locomotive than the cylindrical stack, on account of the decrease of back pressure upon the pistons, which thus increases its mean effective working and lessens the fuel consumption in consequence.

In its general significance, conclusion No. 1 is not applicable to locomotives; the same thing may be said here that was remarked above relative to cylindrical stacks.

FIG. 10.

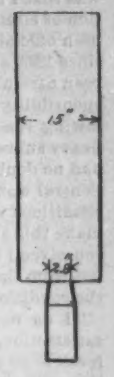


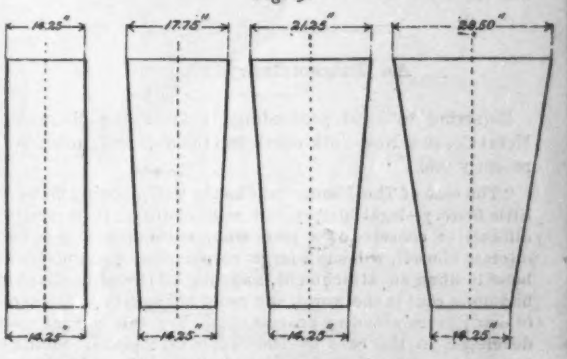
FIG. 11.

The results of the Hanover experiments are also at variance with the statement of No. 2. Zeuner reconciled his theories off-hand by taking a blast nozzle 3.94 inches in diameter, a cylindrical stack of 14.25 inches, diameter with three conical stacks, as shown in Fig. 9, all of whose smallest diameters were also 14.25 inches, while the upper diameters were 17.75 inches, 21.25 inches, and 28.5 inches. He then calculated that the stack with the widest flare—that is, the one with the upper diameter of 28.5 inches—would draw in the most air with a given amount of steam, the blast nozzle remaining the same, and that it is also the most efficient.

The Hanover experiments, on the other hand, showed that if the upper diameter of all stacks is kept the same, while the lower diameter is varied, the strongest draft and consequently the greatest inflow of air will be obtained with that having the smallest diameter. If we start, as Zeuner did, with equal lower diameters, we find from tables X and XII, that give a graphical representation of the Hanover experiments, the very reverse to be the case to what Zeuner theoretically maintained.

The third of the Zeuner conclusions that we mentioned above is also not in accord with more recent experiments, for; as I shall show later on, the conical stacks are not superior to the straight stacks in inducing draft. Both forms, if properly proportioned, therefore, admit of the use of the same diameter of blast-pipe for the production of the same vacuum.

Fig. 9.



Grove: We come now to the mention of Grove as the last to pursue this line of investigation. In a handbook compiled by Heusinger von Waldegg on special railroad technical work, he has handled the difficult question of the blast-pipe in a very lucid manner, has advanced some excellent theories, especially with reference to the position of the blast-nozzle with reference both to cylindrical and conical stacks. His formulæ are especially valuable for locomotives with small grate areas, but for those having larger areas the calculated diminsions are too small.

In his theory Grove followed in the footsteps of Zeuner relative to the action of the draft, and also advocated the superiority of the conical stack. In paragraph X, that has been already referred to, this comparison is pointed out off-hand, and that in connection with the sectional area of the tubes and not of the grate area, whereby the error is called forth. The tradition regarding the superiority of the conical stack is referable to Prusmann. He compared a cylindrical stack, which was evidently too large with reference to the blast nozzle, as shown in Fig. 11, with a conical one whose dimensions were too small. The former had a diameter of 15 inches, and the latter was 11 inches at the waist. The result was that, with the first, the blast nozzle was flush with the bottom of the stack, while, with the conical stack, it was placed 27 inches below that point. Had Prusmann contracted the cylindrical stack correspondingly and then lowered the blast-pipe, he would doubtless have obtained the same improvememt in the action of the draft on his locomotive as he did obtain by the application of his small conical stack.

This demonstration of the equality of the two forms of stacks is one of the important achievements of the Hanover experiments.

(To be Continued.)

The largest man in the world is on exhibition in Paris. He is 6 feet 4 inch tall, and weighs 520 pounds. His upper thigh measures 4 feet 1 inch around; his calves measure 2 feet 11 inches, and his upper arm is 1 foot 11 inches around. He measures 7 feet 4½ inches around the waist. He is a French-Swiss.

Prospects of Electric Motive Power on the Illinois Central.

In an interview concerning the recent reports of the Illinois Central Railroad and its intention of adopting electric motive power for suburban traffic, the following statements were made by Mr. J. F. Wallace, Chief Engineer of the road.

"In 1891-92 I made an extensive examination into the advisability of adopting electric power for the fast world's fair trains, and with a view to adopting the electric system, if any should be established, for the movement of suburban trains after the Exposition. The result of this investigation was that I reported to my superior officers against the adoption of electricity as motive power. The question has not been officially considered by the officers of this company since 1892, although the progress of electrical invention has been carefully watched and I have personally on my own responsibility, as a matter of engineering interest, been following the advances made towards electric traction for heavy suburban railroad service. I have frequently said I had no doubt that some time in the near future the Illinois Central would take up and consider this question and that conditions were gradually shaping themselves which would make this application possible; not, however, from any preconceived plans for the adoption of electric motive power, but from the fact that the requirements of the service made the conditions more favorable for taking this step.

"I do not think the overhead trolley system will give satisfaction, neither do I consider the third rail system feasible on account of the large number of trackmen working on the terminal and the numerous trespassers crossing and recrossing the tracks. The application of electricity to a service like that of the Illinois Central will necessarily be gradual and slow, and any system that may be adopted should be such as would permit of the common use of the tracks by steam power as well. In other words, the question of the application of electricity on this road is still in the air and while current events indicate that the application will be made in the near future, it may be two, three or five years before the question is even seriously considered.

"Inside of certain limits electricity seems to be the preferable motive power for moving small transportation units at frequent intervals and for short distances; while on the other hand steam is the most economical and preferable for handling large units of transportation at infrequent intervals and over long distances. The line of demarcation between these extremes, is, of course, rapidly changing, and the field for the adoption of electric power is gradually increasing as the appliances therefor are more thoroughly perfected and the problems of economical constructions, maintenance and operation are solved."

An Extraordinary Litigant.

Referring to legal proceedings against the Magnolia Metal Co. in a New York court, the *Commercial Advertiser* recently said:

"The case of The People vs. Shanks will probably make a little history—legal history, but still history. It is pretty difficult to conceive of a man who, without any possible interest himself, will sue a large corporation, go on his own bond in filing an attachment, knowing all the while that he had not a cent in the world, and could not satisfy judgments of many years' standing against him. Yet this is what was developed in the case of The People vs. Shanks. Shanks brought an action last spring against the Magnolia Metal Company on an assigned claim by discharged employees, for $7,000. As the Magnolia Metal Company was a foreign corporation, some one had to qualify as surety in bringing an attachment suit. As a matter of fact, Shanks acted both as plaintiff and bondsman. More extraordinary still, he did so on the advice of counsel, who knew his financial condition, and, to add to the incongruity of the situation, his counsel stated that Shanks had no pecuniary interest in the assigned claim in question.

Col. Alexander S. Bacon, of 34 Wall street, did the probing; Mr. Linus A. Gould and S. Victor Constant, of Constant & Coghill, assumed the responsibilities for the action of his client, Shanks, and Police Judge Kudlich heard the case and couldn't see any particular merit in the plea that the alleged perjury was advised by counsel. Colonel Bacon, the attorney for the Magnolia Metal Company, has for years been attending litigation growing out of suits brought by dummies in the interest of large corporations inimical to the Magnolia Metal Company. The petty annoyances have grown to be intolerable, and the company is invoking the law and is bringing these irresponsible offenders to justice. It is an open question whether a trust is not forming in the anti-friction metal business, and the fact that the Magnolia people have the standard metal which, for about the same price, gives three times the same service, has undoubtedly excited the cupidity of competitors who wish to take over the company's assets and good-will without paying for them.

Mr. C. B. Miller, president of the Magnolia Metal Company, stated in an interview that he had traced discharged employees directly to the offices of the National Lead Company, the Hoyt Metal Company and others. He also stated that his company had brought suit against the Sterlingworth Railway Supply Company for $120,000 damages for breach of contract, under circumstances which bear out the theory of an attempted combination in bearing metal. One of the leading stockholders of the Sterlingworth Railway Supply Company is said to be a prominent official in the Standard Oil Pipe Line.

In spite of considerable persecution, the Magnolia Metal Company has thrived to such an extent that its very metal is now in use in most of the navies and railroads of the world as well as in all classes of mechanical industry. However, the adoption of such methods as are disclosed in the Shanks case and the countenance of them by the members of the bar is a serious menace to all honestly conducted enterprises.

Evaporative Trials of Belleville Boilers.

The London *Times* of Oct. 28, contained a notice of the launch of the *Kherson*, built by Messrs. R. and W. Hawthorn, Leslie & Company, for the Russian Volunteer fleet. This vessel is to be fitted with propelling engines which are to indicate 12,500 horse power on trial, the steam to be supplied by 24 water-tube boilers of the Belleville type placed in three seperate water-tight compartments. The boilers are being constructed by Messrs. Maudslay, Sons & Field, at their works at East Greenwich.

The following account of the trial of these boilers was given in a late number of the *Times:*

For the purpose of the evaporative trials the boilers have been built up where they have been made, the furnace sides and ends being constructed of fire-brick in the same way as if they were *in situ* on shipboard. Although partially under cover, they were practically exposed to the condition and temperature of the external air, which were not very favorable. In the two boilers under trial, each of which consists of eight tube sections or elements, a section containing 20 wrought-iron tubes 4¼ inches outside diameter and about 8 feet 6 inches long; the total heating surface is 2,946 square feet and the grate area 93 square feet. As only two boilers were to be tested, a temporary uptake and short funnel were provided, the deficiency in natural draft due to this compulsory arrangement being made up by the application of a steam blast. To insure that all should be in readiness for the official trials, which were to take place on Friday, a preliminary trial of them of six hours' duration was made on the previous Tuesday—the weather being very cold—with results as tabulated below:

Hours of Day.	Coal Burned.	Water Evaporated.	Evaporation per lb. of Coal.	Boiler pressure, lbs. per sq. in.	Blast pressure, lbs. per sq. in.	Coal Burned per sq. ft. of grate.
	Lbs.	Lbs.	Lbs.			Lbs.
11—12...	1,848	16,500	8 92	200	20	19.8
12— 1...	1,747	16,500	9.44	200	23	18.7
1— 2...	1,512	16,125	10.66	195	23	16.2
2— 3...	1,747	16,500	9.44	195	23	18.7
3— 4...	1,792	16,300	9.30	198	23	19.2
4— 5...	1,568	17,000	10.84	198	23	16.8

These figures, when run out to their conclusions, give a mean for the whole six hours of the trial of 9.76 pounds of water evaporated per pound of coal consumed, and 18.23 pounds of coal burned on each square foot of fire grate, the mean pressure of the steam being 197.6 pounds per square inch. During the whole of the six hours the mean temperature of the feed water was 64 degrees Fahr.

With these results, the official trials of Nov. 1 (which were to be of 12 consecutive hours' duration) were entered on with confidence. The weather, however, at the start was not propitious, the air being laden with a heavy damp fog. At 5:40 a. m. the fires were lighted, the temperature of the atmosphere being 50 degrees Fahr.; at 6:20 a. m. the steam gages registered 200 pounds pressure in the boilers; and at 6:30 a. m. the measuring of coal and water was commenced, and continued for purposes of adjustment, when it was found that 18 hundred weight of coal was being burned in the hour and the water evaporated 8.8 pounds per pound of coal. At 8 a. m. the official trial was commenced, and continued for the time agreed upon, terminating at 8 p. m. with the following results, deduced in the same way as for the preliminary trial: The average evaporation for the first three hours amounted to 9.2 pounds of water per pound of coal burned; for the first six hours, 9 pounds of water; and for the entire 12 hours, 8.81 pounds of water per pound of coal, the steam pressure being 200 pounds to the square inch throughout; and the temperature of the feed water 54 degrees Fahr. Welsh steam coal of average quality was used during the trial, and the fires were cleaned at the end of the sixth and tenth hours. At the conclusion of the 12 hours trial, an accumulation test was made to ascertain if the safety valves were capable of dealing with any quantity of steam likely to be produced. The valves were accordingly set to lift at 245 pounds' pressure per square inch, and firing was resumed and coal burned at the rate of from 35 pounds to 40 pounds per square foot of grate per hour. The maximum pressure shown by the gages during the hour in which this test was continued was 247 pounds. During the whole of the 12 hours of trial all the coal weighed was fired, and no allowance made for cleaning the fires or for what had fallen through the grates.

As the Belleville type of boiler is now attracting considerable attention, its more extended adoption in naval and commercial vessels being imminent, much interest was manifested in these tests, which were attended by several engineering experts, in addition to the representatives of the builders.

The "Star" power hack saw, made by the Millers Falls Company, of 93 Reade street, New York City, is a time and labor saving machine, that is worth a good deal more than it costs. The machine will cut metal of all sizes up to 4¼ inches in diameter. It requires no attention after the work is put in the vise, and stops when the piece is cut off. The quality of the blades used in these machines has been steadily improved, as shown by the fact that one blade recently cut off an inch squre bar of wrought iron 246 times. This could not be done in a hand frame, but in the "Star" power hack saw, where the pressure and stroke are regulated and uniform, one blade will cut steadily for a number of days.

The Root Boilers All Right.

In November last a suit was begun by the Philadelphia Edison Electric Light Company, of Philadelphia, against the Abendroth & Root Manufacturing Company, of New York City, to recover $34,000.00. A countersuit was put in by the Abendroth & Root Manufacturing Company against the Philadelphia Edison Electric Light Company, for $6,830.99. This suit was tried in the United States Court in Brooklyn, before Judge Wheeler and a jury, and a verdict has now been rendered in favor of the Abendroth & Root Manufacturing Company for the amount of the countersuit.

The Abendroth & Root Manufacturing Company are the manufacturers of the well-known Root Water Tube Boiler, and between the years 1889 and 1891 they furnished the Philadelphia Edison Electric Light Company with about 3,500 horse power of boilers, these boilers being supplied on four different contracts, each of which followed the other at short intervals. Soon after these boilers were erected and in operation in the Philadelphia-Edison plant, a series of troubles followed, which finally culminated in a fatal accident. This brought the matter into the Coroner's Court in Philadelphia, where, after a careful investigation by a jury of experts, a verdict was rendered acquitting the Abendroth & Root Manufacturing Company, and holding the Philadelphia Edison Electric Light Company responsible.

The troubles above mentioned were due, as claimed by the Philadelphia Edison Electric Light Company, to bad workmanship, bad material and faulty design, and also due to the contractors failing to comply with all the articles agreed upon in their contract, and on these grounds they brought the suit just closed, in which they sought to recover $34,000, which they claimed they had spent in remedying the so-called defects. The Abendroth & Root Manufacturing Company claimed that the plaintiffs had not paid them all that was due on their orders for boilers, and also for additional material furnished to them, and on these grounds they brought the countersuit mentioned above.

The Abendroth & Root Manufacturing Company succeeded in the first place in establishing the fact that they had lived up to every article of their agreement and had even done more than they had agreed to do. In the second place they succeeded in establishing the fact that they had used the best material obtainable in the market. In this connection it is interesting to note that the greatest number of breaks occurring in these Edison boilers were reported to be in the item of bolts; and as it is a natural conclusion that the greatest breakage will occur at the weakest point, it was necessary to establish by evidence the fact that these bolts were equal, if not superior, to anything to be found in the market. Specimens of the bolts were thoroughly tested and shown to be of the best material. The Abendroth & Root Manufacturing Company also showed by means of photographs the tools which they now use in the manufacture of their boilers, and they showed that the best methods of manufacture were employed in making the boilers for the Edison Company.

The Abendroth & Root Manufacturing Company succeeded in proving that the accidents were due entirely to the handling of the boilers by the Edison Company, with the object of forcing them far beyond their rated capacity, sometimes exceeding this rating by as much as 100 per cent. and over. They also showed that the Edison Company employed unskilled labor, and that these employees had instructions to keep steam up to the required pressure irrespective of any demands that might be made on the boilers, and that the whole idea was to keep the lights going which the Edison Company had contracted to supply, without regard to the personal safety of the attendants or capacity of the boilers.

Another very important point established by the evidence was that an excessive forced draft was used in order to drive the boilers to the unreasonable extent to which they were used, and evidence showed that this draft was sufficient at times to support a column of water from three to four nches in height. It was also shown that the feed water used in the boilers was very impure, and that in order to neutralize the effect of these impurities an excessive quantity of chemicals was used with the water.

One of the most interesting points developed was the production of water hammer in the tubes of these boilers, which was explained in the following manner: It is a well-known fact that every pipe or tube has a definite capacity of discharge, and when this capacity is reached no more water or steam can be delivered through an opening of such an area; so that in case a larger discharge is required, a larger tube must be used. In driving these boilers to such an excessive extent, in the course of natural circulation the water and steam passed up along the inclined tubes to the front headers, and there advanced upward into the overhead steam and water drums, from which the steam was delivered to the piping system. When the circulation reached a point equal to the capacity of the tube, of course, no more steam or water could be discharged from that upper end of the tube, but as the heat still continued to be applied around the tube, more steam was generated, and of course the pressure of this steam in the tube forced the steam and water back down the tube until it reached the rear header, and here the steam suddenly had a chance to escape upward by the course of the rear headers to the overhead steam and water drums, and the colder feed and circulating water trying to enter the lower end of the tubes from these same rear headers came in contact with the steam thus seeking passage of escape. The result was a sudden condensing of the steam, which was followed by a rush of water into the vacuum at an exceedingly high velocity, and this water rushed along the tube at about this same velocity until it reached a bend at the end of the tubes. The result was a very sudden and powerful blow there practically like that of a cannon ball, which caused the bolts to rupture in the manner above described, breaking them, in fact, so rapidly that a flow of the metal composing them at the point of rupture was impossible.

This flow necessarily would take a certain amount of time. The consequences of this sudden blow was exhibited in the

breakage of these bolts without contraction of area at the point of rupture. It was remarked during the course of the trial that it was fortunate that these boilers were composed of small headers covered by small castings known as connecting bends, and that thus the damage done affected merely these small castings, producing there local results instead of rupturing large castings, which would, of course, be attended by far more serious ruptures. Glass models were shown at court which illustrated beautifully the theory thus presented, and in such a manner as to carry conviction to the minds of the Court that this was the true theory of the disastrous occurrences. Other glass models illustrated the irresistible power of the water hammer, the force of which was sufficient to break the tubes which held the water surrounded by a vacuum.

The plaintiff brought in as an expert Professor Spangler, of Philadelphia, while the defendant brought in as experts Dr. C. E. Emery, of New York, and Prof. R. C. Carpenter, of Sibley College, Cornell University, Ithaca. Prof. W. D. Marks, of the Philadelphia-Edison Company, and Mr. Albert A. Cary, of the Abendroth & Root Manufacturing Company, also testified as experts on their respective sides.

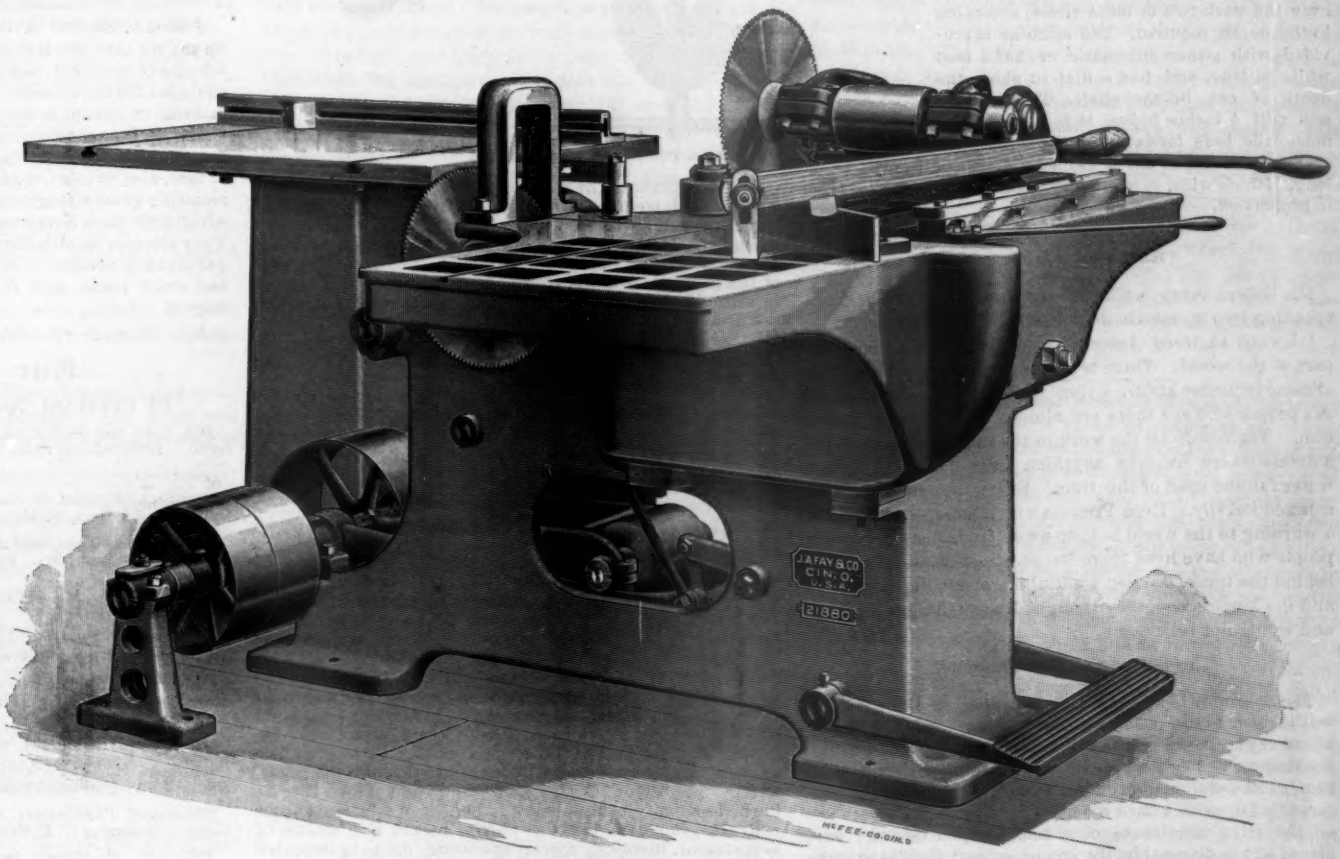
Altogether it is a well-earned and well-deserved victory of the Root Company on which they are to be congratulated.

Improved Car-Brace Cutting-Off Saw.

The use of this machine in any freight-car shop means a saving in time and labor in the cutting of freight-car braces that should command the attention of master mechanics. With it there is no rehandling of the material, no laying out, no preparatory cutting to lengths, no waste material. The angles are cut much more rapidly and accurately.

The framing is substantial; the various shafts and arbors are made of fine steel of proper diameter, and the bearings are long and self-lubricating. The journals are ground true, all joints are planed and the tables are made of iron and adjustments made convenient. The lower saw is mounted in an automatic feeding-carriage controlled by a foot-treadle, and with provision for keeping the belt tight. A saw on top of the table at right angles to the lower saw is carried in an adjustable bearing, which allows the saw to be lowered as it is worn down in diameter. It travels in planed ways, securely gibbed to the table, and operated by means of a lever. The table is provided with adjustable fences and guide-rolls. Adjustable stops are added for holding the material against the fences properly.

A supplemental gage table is supplied, mounted on a heavy iron column. This is used for regulating the length of the braces, and is provided with an adjustable fence across the table. This fence is slotted lengthwise, and has an adjustable stop, the right angle cut by the saws having a perfect bearing against the fence and stop. Two saws eighteen inches in diameter are furnished with the machine. Two counter-shafts are provided, each carrying ten by sixteen inch T and L pulleys. This convenient and labor-saving machine is made by Messrs. J. A. Fay & Company, of Cincinnati, Ohio.



IMPROVED CAR-BRACE CUTTING-OFF SAW.

A lead pipe was recently taken up, which, it is related had carried water to a farm house for 74 years.

A Model Train.

Commencing Sunday, Jan. 5, and daily thereafter, the popular New York and Florida Short Line Limited will be resumed between New York and St. Augustine, via Pennsylvania, Southern and Florida Central and Peninsular, leaving New York at 3.20 p. m. The train will be composed of latest improved compartment cars, sleeping, dining, first-class coach and smoking cars, from New York to St. Augustine. For grandeur and solid comfort there is nothing in the world that surpasses this train. The compartment car is a model of perfection. The entire train is most elaborately furnished, and the country through which the train travels is rich in magnificent scenery, and the one day which is consumed in the trip can be spent most advantageously in taking in the beauties of nature. The announcement of the new train several years ago was one of the great achievements of the Southern Railway "Piedmont Air Line," and the public are highly grateful and have and will continue to show their appreciation to the evident satisfaction of those instrumental in reducing the time between New York and Florida to a minimum. Excursion tickets south have been placed on sale at "very low rates," and those contemplating taking a trip to the Sunny Lands should call on or address Mr. R. D. Carpenter, General Agent, 271 Broadway, New York.

The Boies Steel Wheel Company reports business good, and all departments of its extensive works, at Scranton, Pa., running full time. The No. 2 wrought iron center wheel made by this company is winning great favor among the mechanical departments of roads in many sections of the country.

Reduced Quality Follows Reduced Price of Steel Rails.

Mr. J. F. Wallace, Chief Engineer of the Illinois Central R. R., writing in the *Engineering Magazine* for December, says that while it is true that there has been a steady and uniform decrease in the price of steel during the last quarter of a century, the average standard weight of rail for main lines has at the same time increased from 60 lbs. to 99 lbs. per yard, and the quality has materially depreciated. As an example of the deterioration that has taken place in quality, he states that during the past year he has relieved from a main track on tangents rails that weighed 75 lbs. to the yard which had been in the track only five years; whereas, on the same district and under precisely the same traffic conditions, there still remain in the track 60 lb. rails that have been in service for over 15 years, which it was not considered necessary to renew this season. While this may be an exceptional case, he considers the steel rail which was furnished by the manufacturers 15 to 20 years ago about 30 per cent. better than the rail now manufactured. This is not intended to apply to special high-class rails, which may be furnished by a few rolling mills under superior specifications, but to the ordinary rail supplied to and purchased by the majority of the railroads in the United States to-day.

A Railroad Struggle Compromised.

The long struggle between the Missouri, Kansas & Texas and the International & Great Northern roads for possession of the Galveston, Houston & Henderson Railroad, between Houston and Galveston, furnishing an outlet on the Gulf, has been terminated in a compromise, after being before the State and Federal courts for about three years. The terms of the compromise as agreed on provide that the M., K. & T. shall transfer to the I. & G. N. 4,999 shares of the capital stock of the G., H. & H. at the par value of $100 a share, being one-half of the total amount of the capital stock of that company, less one share, the "Katy" retaining 4,999 shares, and the two remaining shares being placed with some party agreed upon by both the contending roads in order to secure the strict carrying out of the terms of the agreement. In consideration for this transfer of stock the I. & G. N. surrenders the ninety-nine-year lease made in 1883, by which it secured exclusive possession and control of the G., H. & H. property. The agreement further stipulates that both the International and "Katy" shall enter into a joint contract with the G., H. & H., identical in every detail for the transportation of trains, cars, passengers, tonnage etc., between Houston and Galveston. Under this amicable arrangement the two rival roads will at once begin a joint operation of the G., H. & H. track between Houston and the Gulf, and the "Katy" will be able to touch tidewater.

The evening classes at the Young Men's Institute, 222 Bowery, New York, report a large enrollment this season. One of the most popular classes is that in Steam Engineering. The enrollment in this class includes workers from all fields of the practical applications of steam, viz., firemen, engineers, machinists, etc. They are taught the fundamental principles of the science and also its latest developments. By means of textbooks, lectures and experiments, a comprehensive view is taken of the whole subject. Other subjects taught are the commercial branches, arithmetic, bookkeeping, shorthand, English grammar, and technical branches. Carriage drafting, architectural drawing, mechanical drawing, freehand drawing. Some of these require a two and some a three-year course. A new term will begin Jan. 2, 1896. Young men between the ages of 17 and 35 are allowed to enroll at any time.

Manhattan Elevated Railway Affairs.

According to statements made by the Auditor of the above-named company to a committee of the New York Legislature on Dec. 5, the company has 102 miles of single track. In 1895 the company paid the city of New York $590,243 in taxes, while in 1894 $564,300 was paid. In 1895 the company paid $95,000 to the State of New York in taxes, and in 1894 it paid $93,000. The gross amount of bonds outstanding is now $46,500,000, but $8,500,000 of these will be ordered on Jan. 1. The capital stock at present is only $30,000,000. The gross income for the last fiscal year was $9,397,572; the operating expenses, exclusive of all taxes, were $5,413,964, leaving net earnings at $3,983,608. Then there was an income from other sources amounting to $287,134, which makes gross income $4,270,742. The interest on the funded debt was $2,095,722, the taxes, $652,722, making $2,748,694, which sum deducted from the gross income, leaves a net income to the company of $1,522,048. For the year ending Sept. 30 last the road carried 188,072,645 passengers. The total number of passengers carried since the railway started, up to Sept. 30, is 2,410,845,487. The company has about six thousand employees, and pays engineers $3.50 a day for nine hours' work; firemen, $2; conductors, $2.30, and guards $1.85.

President George J. Gould said, when asked what he thought of building an underground railway: "I think it is possible to build an underground railway, but that it would not pay financially. It is not paying in London, where the circumstances are better than they are here." He said that in his opinion an elevated road with electric motive power would be the best system of transit in New York, and that his company was at present experimenting with electricity. He was asked:

"Have you any complaints coming in about overcrowded cars?" "Yes," he replied, "but I don't see how that can be remedied. In the morning everybody wants to go south and in the evening they want to go north. You can't stem the tide. In Third avenue, during the rush hours, we run trains on 50 seconds' headway, and I don't think they can be run safely on much less headway than that." Mr. Gould also said he was aware that complaints were being made about the lighting of the cars, and they were looking about for a better system. "A year ago we were about to adopt Pintsch gas, but electricity came into prominence and we decided to wait. If we adopted electricity as a power, of course we should want to light cars with it."

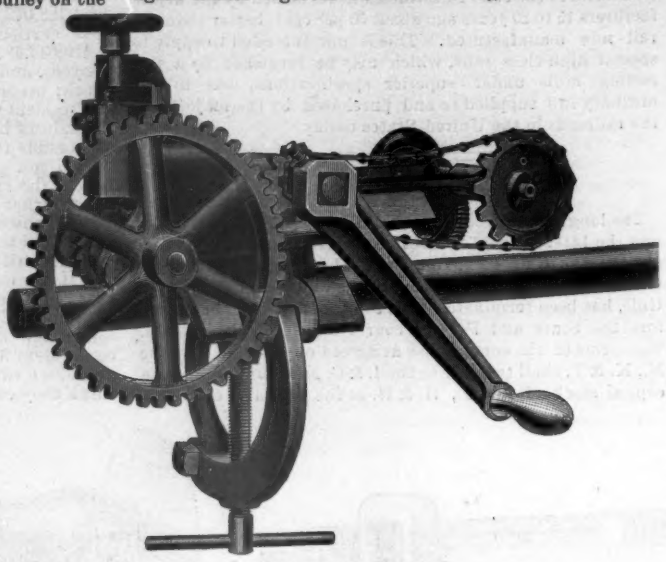
"I don't believe in municipal ownership of railways," said Mr. Gould, "and think it would prove disastrous. Government roads are never run so well as roads run by private corporations. They have tried it in Europe with their military roads, and it has proved a failure. The taxpayers have to go into their pockets every time. The Government, I think, should not go into the business."

American locomotives are now going into Europe. The ordering of 40 locomotives by the Russian Government from the Baldwin Locomotive Works, Philadelphia, Pa., leads *La Genie Civile* to say: "Already in the matter of furnishing railroad material American constructors had taken possession of the South American market and were carrying on a formidable competition against the English in their own colonies, especially in New Zealand and Australia, but it was hardly expected that they should be seen obtaining a foothold in Europe." Why not, pray? Are not American locomotives the most beautiful in design, the most nearly perfect in construction, the most reliable in function, the swiftest in motion, and the best in all essentials of all locomotives on earth? Why should European railroad-builders not have as good taste and judgment in selecting locomotives as the railroad-builders of Australia and South America? Go to! Europe, as an artistic country, should buy only American locomotives, or else compel European builders to build locomotives strictly on the American models.—*Iron Industry Gazette*.

The Lake Portable Key-Seater.

The accompanying illustration shows a very useful machine made by the Lake Brothers, of No. 1645 North Tenth street, Philadelphia. As every mechanic knows, in making repairs in shops, etc., it is a very serious thing to be compelled to take down a line shaft, or any part of it, to have a key-seat cut, or if not removed from its position it is necessary to chisel the same, which is a very slow operation, and not very satisfactory when completed. Often a great deal of trouble and annoyance is experienced by having gears, pulleys, couplings and clutches work loose on the shaft when in use, usually the result of an inaccurate key-seat being cut in the shaft. With this machine it is not necessary to remove the shafting from its hangers or boxes to cut a key-seat, and in this way a split pulley or coupling can be applied very quickly, or if a solid pulley is used it is only necessary to remove the hanger or box, so as to slide the pulley on the shaft, thus saving time, which amounts to a great deal where any number of persons are employed.

Our illustration shows the machine as it appears after having cut a key-way 4 inches from the end of shaft. This machine will mill key-seats any length in shafting from 1¼ inches to 4¾ inches in diameter, and of widths varying from ¼ inch to 1½ inches, and any depth not exceeding ⅝ inch. Each machine is furnished with six milling cutters, which by placing one or more on the spindle of the machine, key-seats the sizes mentioned above, any of which can be cut at one operation the width required. When the cutters are kept sharp the machine will mill all key-seats up to ¾ inch wide, by ⅝ inch deep at one operation, but for the wider key-seats it will be necessary to go over the work two or more times, according to the depth required. The machine is provided with either automatic or hand feed while cutting, and has a dial to show the depth of cut in the shaft. The machine will mill 4 inches before it is necessary to move the base forward on the shaft. An operator can easily cut a key-seat 12 inches long, ⅝ inch wide, ⅝ inch deep in one hour, and other sizes in proportion.



A PORTABLE KEY SEATER.

Africa for Africans.

Mr. Robert Perry, a Chicago contractor, who has been spending two months in Johannisburg, South Africa, says:

"I want to warn Americans to keep away from that part of the world. There is nothing to go there for. The climate is unhealthful, living is exorbitantly high, and the people who are there are almost in a starving condition. Negroes do all the work in the mines. The place is a desert where scarcely anything grows, and there is a water famine most of the time. Every imaginable thing is taxed heavily. Even Pretoria's own paper has printed a warning to the world to keep away from the place. The people who have lived there ten or fifteen years are away behind the times. When I told them about the motocycle and the kinetoscope, they thought I was telling fairy tales, and would not believe me."

The Switzerland of America.

The assembly hall of the Union League, in Philadelphia, was thronged with people on Dec. 27 and 28, to see the exhibition of pictures of scenes along the line of the Lehigh Valley Railroad. The pictures were photographs by William H. Rau, of Philadelphia, made last summer. A locomotive and car, fitted up with a dark room for developing the plates and all the other appliances of a photographic studio, were placed at his disposal by the company, and the 250 or more pictures exhibited are a part of the results of his work.

The region through which the Lehigh Valley Railroad runs has often been called the "Switzerland of America" from the beauty and variety of the scenery. Many of the pictures are of scenes of which the traveler catches fleeting glimpses from the car windows as he is whirled along the Lehigh and Susquehanna rivers. Some of the pictures are of the country in the vicinity of Easton and Bethlehem, Pa., and the series of the vicinity of Mauch Chunk show the river shut in by mountains and the railroad curving in and out along the bank. But the real "Switzerland of America" is not reached until the traveler approaches Wilkes-Barre. Here glorious subjects for the artist are to be found on every side. The pictures of this region are among the most beautiful in the collection. There are pictures of Glen Summit and the beautiful Wyoming Valley, and views of forest, and mountain, and stream from Point Lookout and from Wilkes-Barre Mountain. The photographs of the collieries about Wilkes-Barre, Mahanoy City, Shenandoah and Pitteton are exceedingly interesting and illustrate in a novel way Pennsylvania's great mining industry. The valley of the Susquehanna River offers an endless variety of subjects for the camera. The various views of the river between Falls Station and Towanda show conclusively that the scenery along the river is varied and characterized by a beauty that must inspire the most prosaic nature. Then come the lakes. Beechwood Lake, Shawanese Lake, Lake Ganoga, Seneca Lake, Cayuga Lake, Owasco Lake and Hemlock Lake are all beautifully represented. One of these, Lake Ganoga, stands in a virgin hemlock forest of vast extent. The surrounding mountains are covered with a heavy growth of hemlock that man has never penetrated. Hemlock Lake is not far from Rochester, and although not as well known as some of the others, the prospects for its future are of the best. A new branch of railroad has been run to the lake from Rochester.

Safe Lighting of Mail Cars.

The Superintendent of the Railway Mail Service, Mr. Joseph E. White calls attention agian, in his annual report just concluded, to the necessity of adopting safer methods for lighting mail cars. For several years the Post Office authorities have pleaded with Congress to adopt a measure forbidding the use of oil in lighting the cars in which the mails are carried. In report after report the various superintendents of the Railway Mail Service have called attention to the immense losses caused the Government by reason of mail cars and their contents being burned, either by the explosion or overturning of oil lamps when accidents happened.

Such casualties frequently occur, and, as the report mentioned fully shows, the greater number of fires arising from accidents were caused by the lamps with which the cars were lighted, and only in very rare instances by the fire from the engines. In his report Superintendent White again makes vigorous demand for legislation that will effectually prevent the recurrence of such disasters which involve such tremendous losses. He says:

"The leading bankers, manufacturers, merchants and prominent citizens of this country are very strongly in favor of greater care in the transmission of the mails, because of the immense loss and trouble caused by their destruction in railroad wrecks, when thousands of checks and drafts are destroyed, often taking years to trace up and replace. Furthermore, the average citizen who, after all, pays the freight, has a very decided interest in the matter, from the fact that letters and mementos are often lost which can never be replaced. Every business firm in the United States is vitally interested in this question, because, apart from financial considerations, important communications and orders are lost, which cannot be duplicated and frequently can never be replaced."

Burning Liquid Fuel.

An English paper, in commenting on the burning of liquid fuel, says: Hundreds of patents have been secured for different methods of spraying and burning liquid fuel. The great secret of success seems to lie in so arranging matters that the flame will not put itself out and prevent the oil from being properly consumed. If we put a bit of flaming paper over the chimney of a lighted lamp, the paper will be extinguished by the uprush of carbonic acid from the lamp flame. In the same way, when petroleum spray is directed into a furnace high up it cannot burn because the upper part of the firebox contains little or no free oxygen, the spray is driven unconsumed through the flame, strikes the bridge or fire stone and runs down it to be burned—usually badly—below. The jet of oil should enter near the grate bars, but the precise height is a matter of adjustment, involving special knowledge not to be imparted by letter press. As regards the spraying, that is usually effected by steam, but the practice is very objectionable, because the quantity used is very considerable, and represents great waste of fresh water, which must be made up again for the sake of the boilers, at least in the case of seagoing steamers. The use of compressed air appears to be better, but it is worth while to consider whether either air or steam is needed. It might be found practicable to get rid of both by driving the oil in through very fine nozzles—needled if desirable—under heavy pressure. This device has been employed in oil engines with much success, and we do not see why it should not be made to answer for furnaces.

Low Excursion Rates.

The Southern Railway (Piedmont Air Line) has just issued a circular announcing low excursion rates to Southern cities and winter resorts. The new points to which excursion tickets are sold this winter included many prominent Southern cities. This great system penetrates every Southern state over its own rails: operates solid trains, vestibuled sleeping and dining cars, from New York to New Orleans, Jacksonville, Tampa, Atlanta, Augusta, Ashsville, Chattanooga, Birmingham and Memphis. This is the route that forms the great California Limited via New Orleans in connection with the Sunset Limited, the most elegant appointed train service between the Atlantic and Pacific.

The Riehle Brothers Testing Machine Company, of Philadelphia, purposes printing in a standard 6 x 9 volume, various matters pertaining to physical testing, together with such chemical analyses and other data as may be of value in determining the strength of all kinds of material. This pamphlet, beginning January, 1896, will be issued quarterly, and will be a digest of tests so arranged under appropriate headings as to make of it a ready book of reference.

There will be a receiver's sale of the entire plant of the New York Frog & Switch Company, at Hoboken, N. J., Thursday, Jan. 9, 1896. For full particulars address Mr. F. K. Day, Hoboken, N. J.

The Florida season is now fully opened up and the question of when to start and by what lines to travel is presenting itself to the Southern tourist. A pleasing choice of route is an essential feature of a railway trip. The Cincinnati, Hamilton & Dayton Railway, with solid trains, magnificent sleeping and parlor car service, quick schedules and close Cincinnati connections with the fast lines to Florida, realizes all the possibilities of modern journeying.

Dixon's Silica Graphite Paint, manufactured by the Joseph Dixon Crucible Company, of Jersey City, N. J., will be used in painting all the tin work and skylights of the Post Office Department building at Washington. A quantity will also be used on the Capitol and the District Government Building.

The Chicago Rabbeted Grain Door has been ordered on 600 new box cars now being built for the Norfolk & Western Railroad. These doors are ordered also on 500 new box cars being built for the L., N. A. & C. R. R.

Riehle Brothers' Testing Machine Company have just been notified that they have received a silver medal for the excellence of their 100,000-pound automatic and autographic testing machine exhibited at the Atlanta Exposition. This is the highest award.

The Hills & Jones Co., of Wilmington, Del., has just issued an exceedingly attractive catalogue, presenting large handsome photo-engravings of the special line of machine tools made by this company for working iron and steel plates, bars and structural shapes. The pamphlet is original in design and very artistic.

Messrs. T. Shriver & Co., of 333 East Fifty-sixth street, New York City, are Iron and Brass Founders and Machinists who make large castings in green or dry sand—being fully equipped for the purpose. A feature of their business is the making, on special molding machines, gear wheels of any diameter, face or pitch; no pattern being required from the party ordering; and fly wheels and pulleys of any diameter, or face, also without the necessity of a pattern. For castings requiring great strength they use a special mixture of iron, which they have developed in the course of their experience. They are also manufacturers of overhead traveling cranes particularly adapted to use in power rooms of street electric and cable roads, and they invite correspondence on the subject.

Our Directory

OF OFFICIAL CHANGES IN DECEMBER.

We note the following changes of officers since our last issue. Information relative to such changes is solicited.

Atchison, Topeka & Santa Fe.—Master Mechanic W. E. Symons, of Raton, N. Mex., has resigned.

Birmingham, Sheffield & Tennessee River.—General Manager Philip Campbell has resigned and is succeeded by Samuel Hunt.

Canadian Pacific.—William Apps is appointed General Master Car Builder.

Chicago & Eastern Illinois.—Assistant Superintendent M. P. Albert Griggs has resigned.

Chicago, Burlington & Quincy.—General Manager W. F. Merrill has resigned, and is succeeded by W. C. Brown.

Choctaw, Oklahoma & Gulf.—G. F. Huggins is appointed General Superintendent, vice J. D. Bradford, resigned.

Cincinnati, New Orleans & Texas Pacific.—Master Mechanic I. W. Fowle, of Somerset, Ky., has resigned.

Cleveland, Cincinnati, Chicago & St. Louis.—Assistant General Manager C. E. Schaff is appointed General Manager.

Erie.—W. F. Merrill becomes Second Vice-President in charge of the Operating and Maintenance of Way Departments.

Florida East Coast.—G. A. Miller is appointed Master-Mechanic.

Grand Trunk.—General Manager L. J. Seargeant retires from that position and is suceeded by Charles M. Hays.

International & Great Northern.—W. C. Peterson is appointed Foreman of Motive Power and Car Department. Office at San Antonio, Tex.

Macon & Birmingham.—J. R. Lane is appointed Superintendent.

New England.—T. W. Adams is appointed Master Car Builder, office at Norwood, Mass.

Panama.—General Superintendent A. L. Rives has resigned.

Pennsylvania.—Richard Durborow is appointed Master Mechanic of the West Philadelphia shops, vice M. Garrett, resigned.

Poughkeepsie & Eastern.—E. C. Osborn is appointed General Manager.

Southern Pacific.—R. L. Herbert is appointed Master Mechanic at Victoria, Tex., vice I. R. Garnott, transferred.

St. Louis, Belleville & Southern.—J. W. Karner is appointed General Manager.

Southern Railway.—T. S. Inge is appointed Master Mechanic at Burlington, N. C.

Terminal Association of St. Louis.—E. P. Bryan is appointed General Manager.

Wisconsin Central.—A. D. Allibone is appointed Purchasing Agent, vice J. A. Whaling, resigned.

Employment.

A Master Car Builder and Mechanical Draughtsman, with a large experience in designing and constructing all kinds of cars, is open for an engagement. Best of reference furnished. Apply to office of NATIONAL CAR AND LOCOMOTIVE BUILDER.